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Rayon Dyeing and Finishing—1

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CHAPTER I—METHODS OF RAYON PRODUCTION

General Consideration of Rayon Manufacture

ALTHOUGH many attempts have been made to produce rayon from various gums and resins as well as from gelatin and casein, the commercially successful processes today all use cellulose as their base. The low price of this basic raw material, its abundance, world-wide distribution, and comparative uniformity, make it probable that cellulose will continue as the basic raw material for rayon production. Economic as well as chemical considerations make it evident that cellulose or a related compound (starch, sugar, etc.), must continue to comprise the principal supply of synthetic fiber forming substance.

This is the first in a series of articles on the dyeing and finishing of rayon. It will run in consecutive issues until completed. A synopsis of the chapters will be found in the advertising pages.

At the present writing, rayon has been successfully manufactured on a commercial scale by only four processes. These, in the order of their importance, as judged by production figures, are:— Viscose, cellulose acetate, nitrocellulose and cuprammonium. It is very probable that additional processes will be successfully commercialized in the future.

Chemically, the manufacture of rayon is relatively simple, as few reactions are involved, and practically all of these go to completion. The principle concern of the chemist is to obtain a constant supply of pure chemicals, particularly water.

Physically, the manufacture of rayon is extremely difficult because there are many physical forces involved, each of which is dependent upon all the others. Any minor change in any one of these factors (temperature, time, speed, pressure, etc.), upsets the whole process, and produces a variation in the physical properties of the particular lot involved. Rayon presents many interesting problems to the physical chemist, as the structure of the molecule and groups of molecules called micellae are so complicated that their exact constitution is not yet known. Many explanations, each backed with supporting experimental data, have been advanced, but none of these have as yet been generally accepted.

From the manufacturing viewpoint, rayon is undoubtedly the most difficult commercial product at present being manufactured. Suppose an automobile manufacturer was asked to produce 10,000 automobiles each capable of maintaining exactly the same speed and running continually day and night throughout the year? All who have driven two cars of the same make realize how difficult such a problem would be. Yet the manufacturer of rayon must have thousands of pumps and thousands of spinning pots or bobbins all running continually at the same pressure and speed.

In addition to this, the rayon manufacturer must maintain very exact temperature and humidity control throughout parts of the plant.

The above-described problems constitute only a very small part of the problems, with which rayon manufacturers are faced. The most difficult factor is tension. The slightest variation in tension produces objectionable variations in the physical properties of the resultant rayon. The extreme difficulty of maintaining perfect tension in a plant employing thousands of units can be appreciated by all who have been faced with production problems.

In addition to the highly specialized problems of the industry, rayon manufacturers are also faced with the usual manufacturing problems, all of which are intensified

due to the extreme necessity of maintaining such exact uniformity of product.

Discussion of Cellulose in Its Relationship to the Rayon Industry

All the cellulose at present being consumed by the rayon industry originated from two sources. The most important of these, from a commercial viewpoint, is wood pulp, obtained from northern spruce. The second source of cellulose for rayon, cotton linters, is rapidly becoming more important, largely because of the superior rayon produced when cotton linters are used as the raw material.

Rayon manufacturers using wood pulp as a base have found through experience that northern spruce is the best source of supply of a uniform, strong wood pulp cellulose, high in alpha cellulose content. Other pulp fibers, being cheaper, have been tried by practically all producers, and have resulted in the production of inferior yarns.

The best grades of rayon are today made from a cotton linter base. Nitrocellulose, cellulose acetate and cuprammonium producers use only cotton linters.

Wood pulp, consisting of small bundles of fiber, closely adhered together, can be successfully used in the production of viscose process rayon, because the first important step in the manufacturing process is a strong mercerizing treatment that materially swells the individual fibers and puts them in a very receptive condition for further chemical action. This pronounced swelling allows the bundles of fibers to be uniformly reacted upon and thus makes it possible for a uniform grade of cellulose xanthate to be produced from wood pulp.

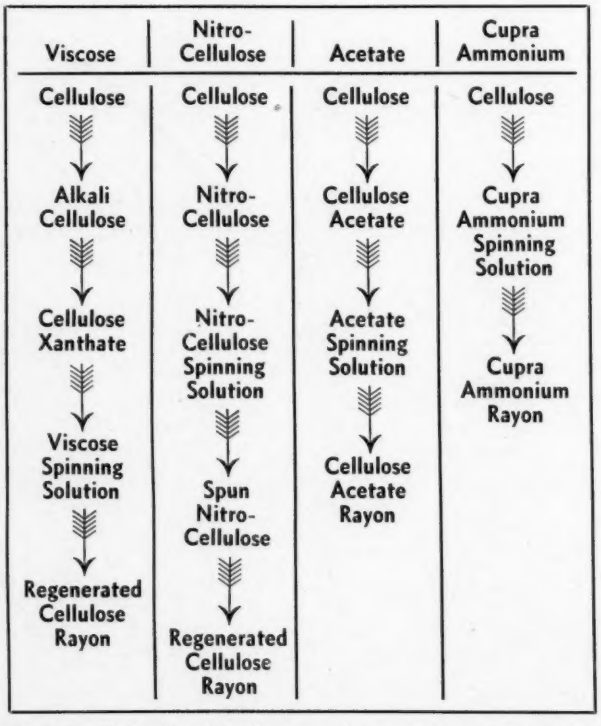

Fig. 1—Simplified outline of the four commercial processes of rayon manufacture

Many viscose manufacturers who were using 100% spruce pulp, as recently as two years ago, are today mixing 30 to 50% of cotton linters with their wood pulp, because it has been found that the superior quality of alpha cellulose obtained from cotton linters, results in an appreciable increase in the strength of viscose process rayon.

Present indications are that, barring new discoveries in methods of rayon production, cotton linters will continue to constitute an increasingly greater percentage of the supply of cellulose for the rayon industry.

As variations are found in cotton linters from different sections of the cotton belt, rayon manufacturers find it necessary to choose their raw cotton linters fully as carefully as they choose their other raw products.

A determined effort is being made to utilize one or more of the sources of cellulose which are at present going to waste each year. Whether or not this work will eventually result in the production of a good grade of alpha cellulose suitable for the present rayon processes, is a question. Nevertheless, it is very probable that one or more of these fibers will eventually be utilized by the rayon industry, even if said utilization calls for variations in process or in the evolution of a new process of rayon manufacture.

Several attempts have been made to utilize corn stalks for the viscose process. Indeed in a semi-commercial way, appreciable quantities of rayon have been made from corn stalk cellulose, although the same have not been considered quite up to the standard in quality. It is possible that corn stalks may some day be the base of commercially successful types of rayon.

Every year, thousands of tons of sugar cane stalks are burned in the sugar producing countries. Sugar cane cellulose may some day constitute a source of supply of alpha cellulose for the rayon industry.

Many wild fibers possessing sufficient strength and uniformity to strongly recommend them as textile fibers have not come into general use largely because of the reluctance of the textile industry to depart from a beaten track. Several fibers, for example ramie and china grass, are admittedly stronger than cotton. Although it is very probable that these will eventually be used directly by the textile industry, which use will put the price beyond the reach of the rayon industry, it is still possible that one or more of these fibers may serve as a new raw product for rayon.

Purification of Cellulose

Raw cotton linters consist of a tangled mass of short staple cotton fibers which cannot be removed from the cotton seed in the ordinary ginning process, but which are subsequently removed by a more energetic treatment.

This second ginning unfortunately causes relatively large quantities of broken seed, etc., to be mixed into the linters. It is necessary that all of this foreign matter be removed from the linters before any chemical cleaning

is attempted. The bulk of this mechanical dirt is removed by repeated beating and carding processes.

Cotton linters freed from the bulk of seed, burrs, etc., are further purified in large kiers. The kier treatment is very long and complicated, as well as drastic in its action; but it successfully removes practically every ingredient other than cellulose from the kier.

Many types of kiers and cotton purification systems have been devised. All, however, consist essentially of treatments in boiling alkaline liquors followed by a cold hypochlorite bleach and thorough rinsing.

Pulp wood logs are pulped for rayon by the well-known sulfite process which consists essentially of the following steps:

(1) Logs are freed from bark.

(2) Logs are cut into chips.

(3) Chips are "digested" or "cooked."

Details of this process vary considerably from plant to plant. Essentially the process consists of a prolonged treatment at an elevated temperature with an acid solution of the bi-sulfite of calcium or a similar base.

(4) Digested pulp is washed thoroughly, freed from dirt and other impurities, bleached (chlorine), washed again, dried and prepared for shipment.

Production of Viscose Process Rayon

The viscose process of rayon production depends upon the fact that cellulose xanthate is soluble in dilute caustic soda, and insoluble in acid. Chemically, the process is simplicity itself. Cellulose is mercerized in strong caustic soda, treated with carbon bi-sulfide to form cellulose xanthate, dissolved in weak caustic solution, spun into an acid bath (in which it is insoluble) and washed free of precipitated sulfur with sodium sulfide.

The chemical reactions of the viscose process are relatively simple in spite of the complexity of the cellulose molecule itself. The reactions, luckily, go to completion. The generally accepted formulas covering the manufacture of viscose process yarn, are as follows:—

1. Alkali—Cellulose formation:

$$C_6H_9O_4OH + NaOH \longrightarrow C_6H_9O_4ONa + HOH$$

2. Xanthation:

$$C_6H_9O_4ONa + CS_2 \longrightarrow CS\begin{matrix}O.C_6H_9O_4\\SNa\end{matrix}$$

3. Ripening:

$$4CS\begin{matrix}O.C_6H_9O_4\\SNa\end{matrix} \longrightarrow CS\begin{matrix}O-(C_6H_9O_4)_4.(OH)_3\\SNa\end{matrix} + 3CS_2 + 3NaOH$$

4. Coagulation:

$$CS\begin{matrix}O-(C_6H_9O_4)_4(OH)_3\\SNa\end{matrix} + H_2SO_4 \longrightarrow 4C_6H_9O_4OH + NaHSO_4 + CS_2$$

Actually the reactions are not as simple as would appear from the above formulae. Other reactions take place simultaneously, the most noteworthy being the oxidation of sulfur (with corresponding reduction of cellulose substance) from combined sulfur with a valance of minus 2 to free sulfur with a valance of zero.

It is only from the physical viewpoint, or rather from the viewpoint of the physical chemist that the chemistry of the viscose process yarn is complex. The physical properties of the spinning solution (the viscosity, etc.), are affected by every factor coming into contact with the cellulose from the time it enters the mercerizing tank, until it leaves the spinning bath. Minute changes in concentration of solution, temperature, time and treatment, etc., seriously affect the final spinning solution. All of these factors must be accurately controlled in order to produce yarn having uniform physical properties.

Cellulose sheets consisting of wood pulp, cotton linters, or a mixture of both, are placed in a large hydraulic filter press, and are treated with strong cold caustic soda solution. After sufficient time has elapsed to allow the cellulose fibers to become completely mercerized, the excess caustic solution is pressed from the alkali cellulose sheets by means of powerful hydraulic rams.

The alkali cellulose sheets after being pressed free from excess alkali are shredded into small bits and are placed into an ageing box where they are held at a uniform temperature for several days during which time a physical change takes place within the so-called alkali cellulose. Exact control of this ageing process is essential to the production of high grade viscose process yarn.

Properly aged alkali cellulose is allowed to react with carbon bi-sulfide under carefully controlled conditions in a large mixing device that resembles a churn. Alkali cellulose reacts with carbon bi-sulfide to form cellulose xanthate, which is a bright orange colored substance.

Cellulose xanthate is dissolved in dilute caustic soda after which it is run into ripening tanks where it is held for a definite time at a uniform temperature in order that the secondary reaction (ripening) can take place.

Viscose material is forced from the ripening tank through a succession of filters into individual spinnerettes. The material is continuously forced from the spinnerettes into an acid setting bath, where the cellulose xanthate is instantaneously converted into a so-called regenerated cellulose under controlled conditions of temperature, tension and concentration of bath.

Viscose spinning baths, or setting baths, contain sulfuric acid as the setting medium combined with various colloidal protective agents that prevent the acid of the bath from acting upon the newly formed viscose, and causing the same to feel harsh.

The newly formed viscose filaments are taken instantaneously and continuously from the bath and are wound on bobbins or drawn into spinning pots.

Plants operating on the pot spinning method run the yarn from the spinning bath over a Godet into spinning pots. This system has the advantage of eliminating the

twisting operation, as the yarn is twisted and wound at the same time. However, in the pot spinning process, it is necessary to skein the yarn before desulfurizing, thus allowing some tangling to occur during the desulfurizing as well as making it necessary that a subsequent winding operation be used if any "put-up" other than skeins is desired by the customer.

The bobbin spinning system eliminates the necessity of forming skeins and thus reduces the possibility of injuring the yarn within the rayon manufacturing plant.

Bobbin spinning is the most economical of the two processes particularly when the yarn is to be sold in any form of "put-up" other than skeins. Pot spinning is the more economical when skeined yarn is sold.

Following the spinning operation, viscose process yarn must be desulfurized to remove the large quantity of precipitated sulfur formed during the spinning operation. This process is carried out in a great variety of ways depending on the equipment available. Plants spinning yarn under the bobbin spinning method naturally prefer to desulfurize on the bobbin.

Plants operating under the pot spinning process must skein their yarn before desulfurizing. Various attempts have been made to desulfurize pot spun yarn in the cake, but for various reasons these attempts have not yet resulted in a commercially successful process.

The precipitated sulfur is dissolved from viscose process yarn by a water solution of sodium sulfide. In the bobbin desulfurizing process, the yarn is desulfurized, rinsed, and given a slight oiling treatment in the same machine. The yarn remains stationary and is treated consecutively with the necessary baths.

Skein desulfurizing plants are forced to move the yarn during desulfurizing and subsequent treatments. These treatments are carried out in a manner that at first sight appears impractical to the textile chemist. Skeins are placed on sticks which are slowly moved forward in the same way that dyed skeins are run through a continuous drying system. As they slowly move through the desulfurizing machine, they are drenched with a succession of baths, the usual routine being:

1. Sodium sulfide desulfurizing bath.
2. Rinsing bath (consisting of dilute sodium sulfide).
3. Pure water.
4. Sodium hypochlorite bleaching liquor.
5. Pure water.
6. Antichlor (sodium bisulfite).
7. Rinsing bath.
8. Finishing bath (contains trace of oil).

Following the desulfurizing. bleaching and finishing operations, the yarn is extracted free from excess water, dried and conditioned. Skeined yarn is inspected for quality and packed pending shipment. Bobbin desulfurized yarn must be twisted and wound in the particular form desired by the customer, after the drying and conditioning operations.

(*To be continued*)

New R. & H. Office

The R. & H Chemicals Department of E. I. du Pont de Nemours & Company, Inc., Wilmington, Delaware, has opened a Charlotte, N. C., office at 300 West First Street, with R. M. Levy as manager. Mr. Levy was formerly in charge of the R. & H. Peroxygen Sales in the New York office. Assisting Mr. Levy on sales is Mr. LeRoy Kennette. Mr. J. C. Robertson and Mr. C. D. Potter, bleaching experts, have also been assigned to the Charlotte office to give prompt service to Southern customers.

The Cleveland, Ohio, district sales office of the R. & H. Chemicals Department, has been removed from 607 Hanna Building to 1235-6 Guardian Building. Mr. Carl Dittmar is manager.

Pratt Institute Alumni

There will be a meeting of the Chemical Alumni Association of Pratt Institute on April 27th at the Hotel McAlpin.

Coignet Chemical Products Co.

It is announced that the Coignet Chemical Products Co. has merged its agency in New York with the International Selling Corporation. This merger became effective on February 1st.

The new name and address will be:

International Selling Corporation, Coignet Chemical Products Division, 70 Pine St., New York, N. Y. Telephone: WHitehall 4-7490.

Colloids, Inc.

At the annual meeting of Colloids, Inc., manufacturing textile chemists, held at the home office in Newark, N. J., Frank A. Nelson, in charge of manufacturing operations, was elected to the board of directors. Alfred Katz, of the technical sales staff, who serves as vice-president and secretary for the coming year, was elected the fifth member of the board of directors. The latter includes in addition to the forenamed, Otto F. Andersson, president; A. D. Andersson, treasurer, and Alexander Waugh. The schedule for 1933 calls for an enlarged manufacturing and research program in the sizing and treatment of artificial silks, real silk and rayon.

To Represent Givaudan-Delawanna

The Industrial Aromatics Division of Givaudan-Delawanna, Inc., New York, has appointed Mr. John M. Pokorny of Allentown, Pa., to represent them in the textile industry in North Eastern Pennsylvania. Mr. Pokorny will operate from Allentown. Givaudan-Delawanna, Inc., are offering Tex-O-Dors, aromatic materials, to deodorize all types of finished goods.

The Colorist and Co-operation*

By **ARTHUR E. HIRST**
Technical Adviser, Carbic Color & Chemical Co., Inc.

ORIGINALLY my subject, I believe, was scheduled as "The Practical Side of Printing." I know that I could give you very little information on this subject, as you are thoroughly versed in the game yourselves, and there is a lot you could instruct me in. So my talk will be rambling and, while nothing new, I hope you may find some things to think about. You will perhaps find as many ingredients in it as in a German printing formula.

Perhaps I might style my talk "The Colorist and Co-operation" and my remarks apply not only to colorists but also to foremen of other departments. Let us consider first the role and advantages of the chemical laboratory.

The man who starts in as chemist of a print works most certainly must take the right attitude from the first. If he gives the impression that he knows it all he must change his attitude, for his education must be completed by overseers. All the books in the world will not teach him the inside workings of a print works and if he doesn't make a good impression on you men he may as well give up. From the time I worked as head chemist in a one-man laboratory, I found that the foremen were willing and eager to help a greenhorn if he discarded any preconceived notion that he knew what it was all about. A chemist's fund of common sense is usually developed by contact with you men. A man can gain common sense and experience if he and you are willing that he should take off his collar and coat and pitch in. This applies not only to color shops but to other departments. I always have regretted not having dug in myself, but my boss decided otherwise by having me tramp around the whole plant. Sometimes a feeling persists in the minds of the plant men that the chemist is trying to get their jobs, but I know that is not so, and any good results from their co-operation is going to rebound to the credit of the overseer more than to anyone else.

The Laboratory

Let us look at some of the advantages of a laboratory. First is the testing of colors for strength and suitability, yet the new chemist cannot even do this properly without your help in directing the practical mixing. Of course, the reputable concerns before the war and now seldom put out colors deficient in strength, but in case of new colors or samples the laboratory can relieve the color shop of detail and loss of time by small trials. Detection of defects in chemicals before sending to the plant also helps to save time and money immeasurably. Perhaps the best example of this was during the war when the chemical organizations of the print works were invaluable in substituting for unobtainable colors and processes which kept the plants running and saved our jobs.

Aside from routine testing, the chemist can have a hand in the solution of plant problems. Here his chemical knowledge may stand you in good stead. As, for instance, a case in which we were printing Para Red for flags, the color decomposed rapidly and tests for neutralization showed that the color had been made up properly. The chemist's knowledge of his science led to the discovery that the color was being decomposed by electrolysis caused by electrical leakage. Simple grounding of the doctor cleared up the trouble.

New Processes

Then we have investigation of new processes which would be time-consuming and expensive on the practical scale. In most cases the laboratory can at least determine the fundamental conditions to work under. You may say that the dyestuff manufacturers should do this, but they are not in possession of facilities for putting in practical trials and have not available ready expert advice such as you men can furnish. Since being connected with a dyestuffs concern myself, I find a pleasant readiness on the part of most colorists to co-operate in every way with the testing of something which shows promise of value to them. As far as laboratory work goes, I have usually found it necessary to go through formulae published by foreign color companies to eliminate unnecessary ingredients. In 1914 the representative of a German dyestuff house instituted experiments to dye Fast Blue B base practically. His formula called for the addition of acetate of alumina to slow down the coupling with the prepare. As a matter of fact we found that reaction was even very slow without the addition of alumina. Moreover, the foreign companies do not always adapt their methods to United States conditions, though they are very thorough in their experimental work.

Even in investigations of other processes outside the color shop the co-operation of the colorist is invaluable. Take agers, for instance, the bug-bear of us all. Much work still remains to be done on the study of ageing con-

* Paper presented before the National Association of Print Works Colorists held in Providence, R. I., Friday, Jan. 28, 1933.

ditions. Perhaps some of you have read the paper by Dr. Rupp of the Pacific Mills at Lyman on ageing. He is conducting a very interesting set of experiments on ageing vats. Without the help of the colorist and his interest in this matter, such as the variation of color constituents, little progress can be made to perfect the process.

Not only can you help the chemist, but he can help you, for example in the testing of your prints to determine their suitability for the trade. You know that some customers have the cute habit of testing fastness with such materials as ink eradicator and the laboratory can usually detect the use of such materials so that you need not worry so much. Even the laboratories of such concerns as the large consumers are not always fair in their tests.

The Technical Societies

While on the subject of chemical helps, may I suggest your consideration of technical societies connected with our industry? Probably most of you are members of the American Association of Textile Chemists and Colorists or the United States Institute for Textile Research or both. They are actively engaged in research, and your membership and active co-operation would be highly appreciated. What they need a great deal is suggestions as to subjects for investigation and your help in conducting it.

Generally, you can use the chemist to help diminish troubles in your plant, even though trouble will always be lurking in the corner.

Research for the good of the printing industry as a whole should be and will be put on a higher plane. We may compare this with the research organizations of the iron and steel industry, the oil industry and others. In this connection it may be interesting to note the comments made recently by a steel man that they were running at 18 per cent capacity and so losing money, whereas if they could run at 30 per cent capacity they would be at least breaking even. Compare this with the finishing industry which was recently running at 105 per cent capacity and still losing large amounts of money. No doubt much of this advantage is due to research in the steel industry to simplify practice. The American viewpoint of research is not as favorable as that of the foreigners who consider that even if only a few valuable facts are discovered, time and money is not wasted.

Co-operation in experimental work is not confined only to the colorists. Consider, for instance, the few improvements made in printing machines and engraving processes. The printing machines are very much the same as they were a hundred years ago, and it is many years since radical changes have been made in engraving. Recently a new adjustable gear has been developed for printing machines and is being used successfully in some plants. In the engraving line there is a new process which is promising and, if any of you gentlemen are interested in a brief outline, I shall be very glad to give it to you.

A Few Improvements

A few improvements in various processes are as follows: In singeing, new burners. Washers have been developed with anti-friction bearings and individually motor-driven nips and agers with outboard bearings. In the bleach house we have all-rubber rolls, kier pilers, and souring with sulphur dioxide. Recent developments in drying have been cans made from seamless tubing with modern siphon arrangements. Motor-driven jigs have proven valuable for dyeing fine goods and, in the finishing process, we have tenters with roller bearings and new swinging regulators, hydraulic calenders with worm drives, and pre-shrinking methods—such as Sanforizing.

Such improvements would be of little value unless tested practically by overseers in the plant. Therefore there is no doubt that your co-operation is invaluable especially when the use of practical machines is necessary.

These days the colorist seems to have two objects in life: to produce particularly novel effects and to reduce costs—a phrase which you may have heard before.

I know what you are up against in this latter respect. It seems that whatever you do to cut costs the saving is given away to the customers. Over this, of course, you have little control—it depends on the courage and common sense of the salesman. This must eventually prevail if our plants are to survive, and those which will survive are the ones which cut costs to the bone and hence get business even if the profits are given away. Naturally the continued existence of our plants is vital to the individual colorist unless you are all so wealthy that you can afford to retire.

It is naturally a temptation to think "What's the use of saving money and then giving it away?" But don't forget that better times will come and all the savings made will then result in greater profits instead of lower loses. Another viewpoint is sometimes met with—the old argument "My processes are going smoothly, so let well enough alone." That's dangerous, for the more progressive men are beating to it the holder of such a viewpoint and, taking up the new colors and methods, smoothing out the bumps, and finally making savings with no more trouble than they had before. I can't help specifying such an instance in my own case where I talked Indigosols with a man who replied, "I don't know about that, you see our vats are running very smoothly and we don't like to change." Yet many other plants are running Indigosols just as smoothly and profiting by it to the extent of decided savings. Most certainly the reduction of costs by new processes requires the best co-operation of the colorist, and it looks as though his jog is going to depend on it, too.

The Cost Department

Perhaps an indispensable type of co-operation from the colorist is with the cost department. This helps to prevent the quotation of wrong prices and so to diminish losses.

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PROCEEDINGS OF THE
American Association of Textile Chemists and Colorists

MARCH 13, 1933

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Getting the Most From Soap*

By **W. W. BRAY**
Director of Laundry and Textile Research, Procter & Gamble Co.

THERE are two steps in the problem of getting the most from soap. The first is choosing the right soap for the job and the second is using the chosen soap most efficiently.

Until recent years the only guide to the selection of soap for a particular process was the experience of the operator. However good this may have been, it was always subjected to the limitation that the only soaps available were those made from naturally occurring fats and oil. The only soaps to choose from were, say, tallow, palm oil, cottonseed oil and olive oil. While these soaps are good in many ways, it is entirely a matter of chance whether one or another is really suited for a particular job. They have not been specially developed for or adapted to any individual process.

Only in the last few years has experience in soap-making been combined with knowledge of textile problems and processes so as to provide an adequate background for choosing a textile soap scientifically. As a result, the relative importance of various properties of soaps has been established in a way that is helpful to clear thinking about soaps. Moreover, there have been developed new soaps and soap-like products especially to fill the definite needs of textile processes.

In choosing a textile soap, the obvious qualification is that it should be pre-eminent in respect to the main work it is called on to do. A fulling soap should promote efficient fulling—a soap for use in any kind of scouring should possess first class scouring ability.

But an even more important consideration is the re-

* Presented at the January 14th Meeting of the Northern N. E. Section at Andover, Mass.

lation of the soap to the fiber. Silk may be thoroughly degummed and yet be greatly reduced in value if it has been harshened or chafed. Wool properly cleaned of its dirt and grease may have been greatly depreciated if tendered or left with a strong soap odor. Cotton may be, in general, well boiled out and yet so specked with lime soap as to require extra and costly treatments.

The relations of soaps to the textile fibers may be classified as both chemical and physical.

Chemical	*Physical*
1. Degree of hydrolysis	1. Solubility
2. Degree of preferential absorption	2. Viscosity
3. Stability toward oxidation and rancidity	3. Rinsibility
	4. Stability of fatty acid emulsion
	5. Characteristics as finishing agent.

Since the influence of these factors have been discussed in detail in our "Textile Bulletins," we need not elaborate on them now. It should be emphasized, however, that these items are the ones which really determine the suitability of a soap for a specific textile purpose.

Efficient Use of Soap

The second part of the problem, the efficient use of soap, means the use of soap in exact proportion to the needs of the work to be done, with suitable assistance from alkali or other aids as the material under treatment demands or permits. In many individual instances, the use of soap by rule of thumb methods supplemented by careful observation has reached surprising degrees of efficiency. In probably the majority of cases, however, it is safe to say that efficiency has been sadly lacking. This means not only excessive costs due to using too much soap. Many times it means poor quality because too little soap was present to function properly and thoroughly. Efficiency in soap usage also means control of the many operating variables such as temperatures, time intervals, amount and condition of water, not forgetting the amount and manner of rinsing.

Many points could be dwelt on which have heretofore been considered in more or less scientific fashion, but which always deserve further discussion. There is one relationship, however, the importance of which our recent work has strongly emphasized. That is the relationship of soap concentration to performance.

This problem was first worked out from a laundry background, but conditions in many textile processes are closely analogous to laundry washing and the conclusions are immediately applicable. Fundamental investigation was carried out in laboratory equipment where every variable was completely controllable. Later on, confirmatory wash tests were made in large scale power laundry operation to make sure that the laboratory results would reproduce themselves in actual practice.

Extensive preliminary studies had indicated that no physical or chemical property of soap would serve as a guide to its dirt removing power. Surface tension reduction, surface viscosity, foaming power, extent of hydrolysis, alkalinity or pH of washing solutions—these and other properties were found to be quite unrelated to the ability of a soap or soap and builder solution to remove dirt. We were forced to the quite logical conclusion that the only way to determine dirt removing power is to measure dirt removal.

For this purpose we resorted, as indicated above, to laboratory and power laundry wash tests. A specially prepared, sensitive soiled towel was developed and proved to be a successful tool for measuring the dirt removed by a given wash. Washing conditions were systematically varied to determine their individual effects. But the interesting indications of some of the earlier results focused attention chiefly on the effects of varying soap concentration.

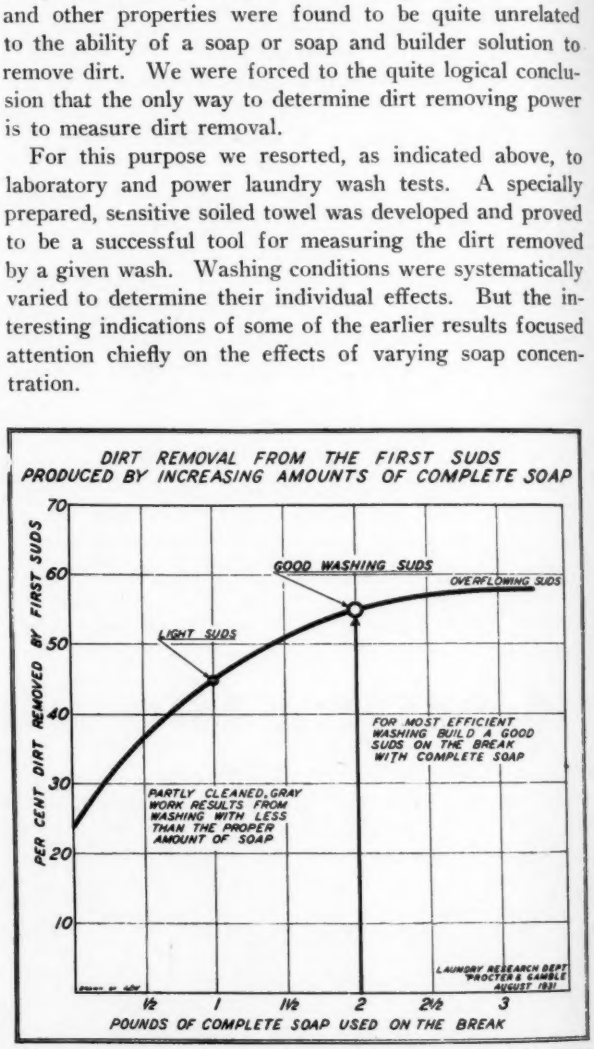

Fig. 1—Dirt Removal Produced by Increasing Amount of Soap in Commercial Laundering.

Figure 1 illustrates clearly how dirt removal increases with increasing amounts of soap used. The curve mounts rapidly for two-thirds of the way and then tapers off and rises very gradually. The first stopping point on the rising curve is the point marked "light suds." This represents the quantity of good soap properly built which had been considered good practice in the past. At the start of the operation a light suds is built but this soon dies down as the soap penetrates the load and works out

the dirt. The result is merely a slippery feeling of the water rather than an actual suds. It is clear from these results that this is not the most efficient point at which to work.

The curve continues to rise rapidly, showing that more soap removes correspondingly more dirt. At a certain point, however, this rapid rise stops and the increase in dirt removal with increasing soap becomes very gradual. This breaking point in the curve represents conditions of efficient washing. It represents the greatest dirt removal that can be economically obtained in this one operation. Smaller quantities of soap give correspondingly poorer washing. Larger quantities increase the dirt removal slightly but not enough to justify the extra cost. Obviously, therefore, it is highly desirable to use just enough complete soap to obtain this economical maximum dirt removal.

This work, combined with considerable experience and much observation of the use of soap in textile processes, led to the general conclusion that an efficient washing concentration exists in every operation for which soap is used. Consequently, the efficient use of soap can be redefined more exactly as the use of soap at this effective concentration or in just sufficient excess of that concentration to maintain a factor of safety.

The problem of using soap efficiently thus becomes one of attaining and recognizing the correct soap concentration. Can we recognize the efficient washing concentration when we see it, or can we establish methods of control which will insure operation at or slightly above that concentration?

Reverting again to power laundry experience for a moment, we have been able to show that by using a properly built soap to make heavy suds in the washing machines, we can attain the effective concentration for at least part of the process under average laundering conditions. Although in most cases the final directions for the efficient use of soap may not be as simple in textile processing as in laundering, nevertheless there are various definite signs that guide the textile operator in its use.

For example, we have long recognized the existence of a maximum effective proportion of soap in degumming silk. For the average silk piece goods we established the fact that between 35 and 40% soap on the weight of the silk produced the maximum rate of degumming. This was determined by small scale boil-off tests with bone-dried weights made before and after boiling off small strips of silk with increasing proportions of soap. In such a case, the efficient use of soap is simply a matter of maintaining this correct percentage of soap to be used on the weight of the silk.

Again, in scouring raw wool, simple tests can be used to control and adjust operating conditions. In the first bowl the addition of a suitable indicator to a small sample of the scouring liquor is enough to show whether it is definitely alkaline or not. In the second bowl, wherein usually the real effort of scouring must be exerted to remove the final small percentage of grease and dirt, we must correlate several factors to reach the desired end. First, we must work with a proportion of soap to alkali which we know is capable of efficient dirt removal. Second, we can judge quite accurately as to the efficient concentration of this detergent by the appearance of the bowl liquor; the liveliness of the lather or bead. Thirdly, we can judge the actual performance of various scouring solutions by ether extractions of the scoured wool. From all these indications, we can prepare detailed instructions for the operation of the scouring system. These instructions may be as detailed with respect to different types of wool as we wish to make them, or they can be adjusted to produce a generally good average of quality of work.

In cloth scouring, the best guide is the suds or lather produced provided that we are working with a ratio of soap to alkali which we know to be capable of efficient work under the circumstances of operation. In general, a rich, creamy lather or a high suds in the washer when the correct proportion of soap and alkali is used, is a fairly sure indication that the efficient concentration has been attained.

We recall one particular good example of this. Heavy, plaid-back overcoating, made largely from re-worked wool, was being scoured after fulling. The fulling soap alone formed a loose, frothy lather in which flecks of dirt were quite apparent. Samples of the cloth cut from the pieces at this stage and rinsed by hand showed a high residual oil content. The gradual addition of a soap and alkali solution correspondingly improved the lather until a thick, creamy consistency was obtained. Although the lather was dark due to the excessive dirt, oil and loose dyestuff present, it had the characteristic appearance of being effective. A sample of the cloth taken at this point showed a low oil content after rinsing. The addition of soap was continued, up to a considerable excess. The lather scarcely changed at all and the suds failed to build up above a rather low level, just covering the cloth in the bottom of the washer. This was no doubt due to the excessive quantities of dirt and oil present. A sample of cloth, upon ether extraction, showed the same oil content as the one taken when the lather had reached a rich, creamy consistency. In this as in many operations of like nature, if we use an efficient proportion of soap to alkali, we can usually depend upon the lathering of sudsing qualities of the soap as a guide to its efficient concentration.

The value of an adequate concentration of soap to work efficiently is also illustrated very clearly by certain difficulties met with in kier boiling cotton. Only too often a kier of cotton after boiling out is found to be gen-

erously sprinkled on top or throughout with specks consisting mainly of lime soap and wax. Of course, the subsequent removal of these specks is attended with considerable difficulty and expense.

Kier Boiling

In kier boiling, the work to be done is one of the most difficult scouring jobs there is. The natural wax of the cotton is difficult to remove and emulsify. Various other substances must be removed, some in solution, some after chemical attack by a boiling alkali. There seems to be no uniformity of opinion as to whether or not soap should be used in kier boiling. From the standpoint of cost, it is sometimes questioned. On the basis of performance, it can hardly be argued seriously that soap does not improve the result in many ways.

What many operators overlook is the fact that whether or not soap is added, some soap is practically certain to be present anyway. Most cotton contains minute quantities of saponifiable oil, either in itself or as contamination from the cottonseeds. This oil is soon converted to soap in the boil. In a vast number of cases, this small percentage of soap does more harm than good. Cotton bleacheries, on the whole, use fairly soft water but very few of them use completely softened water. In consequence, the hardness of the water used in kiering combines with the soap formed in the kier to produce troublesome lime soaps.

Possibly a great deal of the objection to soap in kier boiling is based on the use of too small a quantity; a quantity which would do little or no active good but, due to the hardness of water present, can do positive harm by the formation of lime soap. We have met with many cases in which the quantities of soap used in kier boiling were ridiculously small—so small that they would hardly satisfy the absorption demands of zero soft water and the cloth load, let alone do any active scouring.

If soap is to produce the real benefits of which it is capable in kier boiling, it must be used in amount or concentration sufficient first, to overcome any water hardness that exists, second, to satisfy the absorption requirements of the load, and third, to emulsify thoroughly and permanently the insoluble impurities of the cotton fiber. The efficient concentration can be determined only by trial, using various concentrations and noting carefully the results. Any tests, chemical or physical which can be used, such as color, weight, absorptive qualities and, perhaps, acetylation should be applied to determine the effects of the variation in concentration and to select the optimum soap concentration.

Fulling

One of the most difficult operations in all textile processing in which to judge the correct concentration of soap is that of fulling. When fulling in the grease, as is customary in average American practice, the oil and dirt in the cloth must be emulsified before proper felting and shrinkage can take place. The fulling mill thus becomes a very efficient scouring machine. The amount of soap used should be enough to emulsify completely the oil and dirt present and to leave enough over for the softening and lubrication of the wool fiber which are necessary to good fulling.

In fulling, the soap is applied as a relatively concentrated solution and for any given concentration the maximum amount of soap which can be applied is limited by the amount of water that the cloth should hold. Thus to put more soap on the cloth, we must use more concentrated solutions and vice versa.

Since the amount of solution applied can be made constant in a given plant and for a given style of cloth, the question of the amount of soap comes down to the concentration of the fulling solution itself. Again the sudsing characteristics of the soap can be of some help. We believe that a correctly soaped cloth in the fulling mill should show a beady or foamy appearance on its surface due to the working in the mill. Certainly when a fold of the cloth is twisted between the fingers, the liquid that runs from the cloth should be richly foamy and creamy.

Here another factor enters which is held in great esteem by finishers as a means of judging the amount of soap to use on cloth in fulling. This is the viscosity or body of the liquid squeezed from the cloth. Any attempts to judge by the feel of this liquid are based on the fact that a stable emulsion feels creamy and well lubricated, while a broken-down emulsion feels watery, thin and a little sharp. In spite of the many variable factors which can affect the consistency of the liquid, this test can be of considerable value provided proper allowances are made.

The most important of these allowances is in respect to the natural variations in viscosity of soap solutions of different types. Soaps exhibit a tremendously wide range of viscosity, from the thinly fluid solutions of sodium oleate, relatively little affected by temperature, to the highly viscous palm and tallow soap solutions, which are thick, syrupy liquids when hot and more or less hard jellies when cold. These differences seem to have led to a certain amount of confusion in judging the worth of fulling solutions.

The finisher desires the well lubricated, creamy feel of the liquid in the cloth being fulled which indicates thorough emulsification of oils and dirt. If this liquid has a high viscosity, the desired feel is more pronounced and the finisher is pleased. He has what he calls a "good body" in his fulling soap. The use of the term "body" emphasizes still further the idea of viscosity. The result is that the finisher comes to think that a heavy body or high viscosity is an important and valuable property of a

fulling soap. Without consciously realizing the fact, he has transferred his thought from the vitally important need of maintaining a satisfactory emulsion to the quite unimportant one of having a very viscous fulling soap solution.

For the viscosity of a soap solution has no bearing on its ability to form and maintain an emulsion. A fluid oleate solution can do this fully as well or better, perhaps, at the temperature of cloth finishing, than a syrupy or jellied palm or tallow soap solution. What is necessary is that there be enough soap on the cloth to take care of the dirt and oil present. As we have seen, the quantity of soap placed on the cloth depends solely on the concentration of the fulling solution.

The fundamental and important thought relating the fulling soap solution to its work on the fabric in the mill is that of concentration—concentration of soap (and alkali) so adjusted that the amount of solution which will properly wet the cloth, will contain enough soap to clean thoroughly and full the cloth. In place of the misleading term "body" to describe fulling soap solutions, we suggest the substitution of a definite concept of concentration. By thinking in terms of concentration, the finisher will be thinking realistically. It is the concentration of soap that controls the result and concentration that can be adjusted to get the desired results.

Thinking in terms of concentration will eliminate the discrimination between soaps on non-essential grounds; grounds such as viscosity of solution which have no relation to the scouring or fulling ability of the soap. It will permit the consideration and selection of soaps free from the influence of misguided prejudices toward high titer, hard fat soaps for fulling simply because they make extremely viscous solutions; in other words, because they have a good body. In this way it will open up to the finisher a large and from all indications very advantageous field of operation; namely, that of using low titer soap.

We have had a number of experiences in mills where too little soap was used in the fulling mill and too much in the washer. The reason for this could be traced directly to the use of high titered soaps. Even low concentrations of palm and tallow soaps form such viscous solutions or stiff jellies that higher concentrations containing enough soap to be efficient are almost impossible to apply. On the other hand, the wet finisher can handle low titer soaps in practically any concentration with great ease. He can, without difficulty, determine and employ the necessary and efficient soap concentration on any sort of fabric from the finest worsted, practically clean and with very low oil content, to the dirtiest shoddy laden with mineral oil.

It is not necessary to dwell upon the advantages which follow upon the efficient use of soap in the fulling mill—quicker and more even fulling, less staining with loosened dyestuffs, a cleaner fabric as the result of utilizing the powerful agitation in the mill—working the oil out of and not into the cloth. Following such fulling conditions, the scouring can usually be done with a minimum of added soap and often with none. Considering fulling and scouring as a whole, the efficient use of soap in the mill will save soap over all.

The examples we have discussed illustrate typical processes among many in textile application of soap in which its economical use depends directly on locating the efficient concentration and maintaining it in use. This idea has its roots in sound common sense as well as in scientific investigation. Thus it is doubly sound and can be recommended as a fruitful way of getting the most from soap.

Discussion

Mr. Grimes: What is the proper ratio between soap and alkali?

Mr. Bray: That all depends upon the conditions of operation, the types of fabrics being handled, and the types of soiling matter. Certain types of dirt can be handled efficiently with neutral soap. In general, these are what we call the non-oily types of dirt. In laundry operations, partly because of the greater simplicity of operating conditions and the materials that are handled, we have worked out more exactly the proportions of soap to alkali. As a result, we can say quite definitely that a ratio of two parts of soap and one part of soda gives the greatest dirt removal of any mixture of these two materials. Corresponding relations apply with other alkalies. Trisodium phosphate would be used at about the same ratio; sodium metasilicate or caustic soda, stronger alkalies, in lower ratios. In textile operations, the thing is not so simple. In the first place, the nature of the fiber is often such that we cannot use alkali in its most efficient proportion if at all. In silk degumming, considerable scouring or emulsification of oil must be done. Alkali has no place here. On the finest grades of woolens and worsteds also, there are many operations where alkali cannot be used.

Aside from these factors, the nature of the dirt and the amount present play important parts. Different types of oil are encountered and these various types often have different optimum ratios of soap to alkali. For example, it is in general easier to emulsify a vegetable oil than a mineral oil. There is a good deal of indication that efficient scouring can be done with a lower proportion of alkali on vegetable oil than on mineral oil. Then again, very often more or less oleic acid is used in combination with other oils, vegetable or mineral, in the oil base used for spinning. Some of the alkali added for scouring combines with the oleic acid to form soap. This

modifies the ratio of soap to alkali and consequently some allowance for the reaction of the soda ash must be made in comparing the scouring solution.

As a general rule when soda ash is used for the alkali, a ratio of from two parts soap to one of alkali up to one part of soap and one of soda ash, covers the range of efficient scouring mixtures.

In scouring raw wool, conditions are different again. A great part of the alkali added to the scouring bowls enters into a chemical reaction and is no longer alkali. We may add to the scouring system anywhere from two to four times as much alkali as soap. However, that does not mean that we are scouring with that ratio of alkali to soap. The alkali has combined chemically with certain acidic materials in the raw wool. The resulting compounds are more of a soapy nature than of an alkaline character. The result is that we must consider this reaction first and use enough alkali to take care of it. Over and above that, we can establish our optimum ratio of soap to alkali. For example, in the first bowl we would add alkali to neutralize the acid material in the raw wool. In the second bowl, we would add soap and alkali in proportions of two to one, or one to one according to the nature of the wool and the amount of grease present.

Mr. Grimes: From your practical experience, can you readily for a given condition, tell what would be the best proportion of soap and alkali? Can you determine it on the job or is it a laboratory job?

Mr. Bray: You can get considerable help from the laboratory. Various scouring conditions can be set up and suitable proportions of soap to soda studied. Ultimately, however, some adjustment or trial runs must be made in the plant. Assuming that you can stand the alkali on the cloth, the best general ratio to start with, is two parts of soap to one of soda.

Mr. Christison: There is one point you brought up, judging the efficiency of the scouring by the amount of extractable material in the wool. Your limits are higher than some of us expect.

Mr. Bray: In the case I mentioned, .7% was proved by practical examination of the cloth to be a satisfactory figure for a residual oil. In other cases, it might be necessary to obtain a much lower figure — .2 or .3%.

Mr. Christison: That is the point I had in mind, for speaking from our own experience, we consider .7% as high and we would rather associate that with trouble. Our experience has been that cloth that is trouble-free should contain no more than .2% extractable material. It would be very interesting to hear from some of the other mill men on that point. Personally, I think that .7% is rather high.

Mr. Bray: I quite agree with you on that point and the whole thing depends upon the nature of the cloth you are scouring. The cloth I mentioned was a plaid back over-coating. In the case of fine worsteds, we have had other experiences which indicate that less than .2% is necessary for proper cleanliness. In scouring before piece dyeing, it is often a simple matter and probably advisable, if not necessary, to reduce the ether extractable material practically to zero.

Mr. Christison: Then we agree all right. In the case of raw wool, what would you consider a reasonable amount of extractable material?

Mr. Bray: There again it depends upon the type of wool and the use to which it is to be put. Fine worsted wools should be scoured to 1% or less residual grease. Coarser wools may be allowed a maximum of 1.5%, or in the case of carpet wools, as high as 2%.

Method of Extraction

Mr. Weeks: What is your method of extraction?

Mr. Bray: We use ethyl ether to remove residual wool grease and spinning oils. Following the ether extraction, an alcohol extraction removes material sometimes considered as soap.

Mr. Leitch: What do you consider it?

Mr. Bray: The alcohol extract includes the soap and some additional substance which is probably part of the wool itself. In order to determine the soap, the alcohol extract must be dried, taken up with water, acidified and extracted with ethyl ether. This separates the free fatty acid from the other extracted material. These fatty acids can be calculated to soap and theoretically this procedure is fairly accurate. The practical experience we have had, however, does not justify the assumption of dependable accuracy.

Mr. Leitch: Where does the lime soap come in on that extract?

Mr. Bray: The lime soap does not come out in the alcohol extract. It can be determined by separate acid treatment of cloth, followed by an ether extraction. Although the alcohol extract removes more than soap, the ratio of the total extract to the soap content of the extract seems to be fairly constant. Consequently, a simple alcohol extraction gives a fairly dependable guide to the residual soap in the cloth. The extract gives more than the soap, but it can be used as a guide in adjusting operating conditions.

Mr. Leitch: Have you that ratio in mind?

Mr. Bray: Our evidence indicates it will average about 60% of the total. I think that it will vary a great deal with different types of wool. In the particular case which we gave a fairly thorough study, we worked on a good grade of worsted cloth.

Mr. Leitch: You would consider not only the cloth scouring, but the wool scouring influencing the extracting of the cloth.

Mr. Bray: The residual grease of poorly scoured wool will certainly affect cloth scouring. However, wool grease is one of the most easily emulsifiable forms of fatty or waxy matter. It is easier to remove than olive or mineral oils which might have been used for wool oiling. For this reason, it probably would be removed first in cloth scouring. In any case, the ether or alcohol extractable material in a well scoured cloth is so small that either oil or soap left over from previous treatments would hardly have any great influence.

Mr. Hird: Are you able to measure the efficiency of the sulfonated fatty alcohols by the suds they produce in the same way that you can with soap?

Mr. Bray: We are trying to establish the relationship in that respect. That whole subject is so new that we haven't been able to complete any evaluation of it as yet. There is a strong indication that you can use these materials on somewhat the same basis, that is, by judging the quantity of the suds produced. There are also indications that they can be used efficiently without suds. I think such instances are likely to be rare.

Mr. Grimes: Have you experimented with the standard soiled towel as to its effectiveness for scouring comparisons? How is the standard soiled towel made up?

Mr. Bray: The soiled towel is made from a piece of white muslin which is soiled with a mixture of carbonaceous and oily dirt which our experience has shown will represent, although not exactly duplicate, the dirt in the average laundry bundle. By that, I mean we have established a proportion of carbonaceous material to oil and a total quantity of soil to place on the cloth which serves to gauge the dirt removing power of a laundering process on the average bundle. From experience, we know that if the towel is washed clean, the bundle will also be washed clean.

We are quite sure that this particular towel has almost no application to textile scouring. In raw wool scouring this towel would be very little affected because of the low temperature and the limited agitation. The solutions used in raw wool scouring have good detergent powers, but the nature of the work limits the amount of agitation. The saving factor in this application is that although there is a tremendous quantity of grease and dirt to remove, the grease is one of the easiest fatty or waxy materials to emulsify. The grease serves as a binder for the dirt and once the grease is emulsified, the dirt practically falls from the fabric.

In cloth scouring, the soiled towel would be very hard to apply. The laundering processes for which this towel is designed, operate with temperatures up to 170 to 180°. When applied to low temperature washing with a maximum temperature of 100°, it is not washed anywhere near white. We are not optimistic about the possibilities of developing a soiled towel to serve as a gauge for cloth scouring. In the first place, we already have a very accurate guide to the removal of oil from the cloth, in other words, the ether extraction. In the second place, we don't believe any measurement of detergent action will serve as a guide to producing a uniformity in the cloth, which for example, would insure level dyeing of piece dyes at all times.

Mr. Christison: Do you differentiate between the solvent properties of ether and carbon tetrachloride? For instance, there are some indications that soaps are not soluble in ether and are more soluble in carbon tetrachloride. Have you tried to use ether first and then use tetrachloride second?

Mr. Bray: No, I don't know that we have done exactly that. We investigated carbon tetrachloride and found it unsatisfactory because the results were higher, as compared with ether extraction. Ethyl ether removes all of the oily fatty and waxy matter from yarn and cloth. It is the quickest and easiest solvent to use and our laboratories are well accustomed to using it. For these reasons, we have adopted ether as a standard extraction agent.

Mr. Christison: Don't you think that the very fact that the tetrachloride extract is higher is a poor excuse for its not being used? Isn't that in its favor?

Mr. Bray: Not necessarily. I think we can depend upon ether to remove all fatty matter, even oxidized fats from the wool and I think the fact that carbon tetrachloride may remove more indicates that it is extracting some of the wool substances. We know already that alcohol extracts something more than merely soap. In this connection, we tried another experiment—an extraction with water. Soap is far more soluble in water than it is in alcohol. We tried to get the residue of soap with a water extraction. However, during the extraction the cloth turned brown and looked as though it had been scorched.

Mr. Christison: Do you really think the tetrachloride takes out more than oil?

Mr. Bray: I simply feel that the ether gets all of the true fatty matter and if the other solvents give a higher extract, they are taking something else besides natural or added fats and oils. Our own experiments and those of other investigators indicate that ethyl ether can be depended upon to remove all fatty matter.

Dr. Chapin: Illustrating the ability of wool and related fibers to neutralize alkali I made a few years ago some experiments, the results of which are suggestive, even though too few to be conclusive. Taking two samples of luster wool and three of mohair I extracted each with distilled water and measured the pH of each extract. I found the mohair extracts all lower in pH than the wool; but after adding the same amount of dilute alkali to each, I found that the mohair extracts had jumped above the wool in pH. Thus the mohairs, ap-

parently more acid at the start, seemed to have their acidity less well buffered, so requiring less alkali for its correction. Similar differences no doubt exist between different kinds of wool.

Neutralization

About this same matter of neutralization I should like to ask a question of Mr. Bray. At the beginning of a day's run in wool scouring it is of course easy to make the baths too alkaline, even with soda ash. But in the afternoon, when the bath has become well buffered, is soda ash strong enough alkali to keep the first bowl economically at high enough pH for the best scouring?

Mr. Bray: We have given some thought to that subject. We think the phenomenon of the soda ash appearing weaker is the result of the rapid building up of bicarbonate in the bowl. The presence of bicarbonate tends to reduce the scoring efficiency. There is a decided field for further investigation of the use of strong alkalies. We have seen no publication of dependable work on the subject. Various people have indicated that the use of caustic soda is helpful, but there are no directions for its use that we are acquainted with.

Prof. Olney: There is one question I would like to ask—Provided you should add enough of one of these sulfonated higher alcohols to a hard water in sufficient quantity to take care of the lime, and you add soap after that, does the lime affect the soap or is it already taken care of by the Gardinol?

Mr. Bray: Although we can't answer that question completely, we can give some observations we have made. From a chemical standpoint, we would assume that if enough Gardinol were added to hard water, the calcium and lime compounds would react with the Gardinol to form an equilibrium. If we then add soap, we would expect a re-adjustment of the equilibrium so as to form a certain amount of lime soap, changing a part, at least, of the calcium Gardinol compound to calcium soap. We would expect this because the lime soap is completely insoluble whereas the Gardinol compound is quite soluble. Now, on the other hand, suppose we start in the reverse direction and make lime soap by adding hardness to a soap solution. We add enough hardness entirely to kill the soap. A layer of calcium and magnesium soap separates out. The addition of Gardinol to that system containing lime soap and water emulsifies the lime soap to form a milky liquid. Upon standing, no layer of lime soap separates out. After 15 or 20 minutes perhaps, the liquid shows a distinct tendency to clarify. It tends to become translucent. This seems to indicate either that calcium or magnesium Gardinol compounds are formed in preference to the insoluble lime and magnesium soaps or else that these latter soaps are soluble to some extent in a Gardinol solution. This effect seems to depend entirely upon the concentration of the solution and it probably has considerable practical value.

Kinds of Soap

Mr. Grady: Speaking of soap, I wonder if you have in mind tallow soap or is that where you would recommend the red oil soap. Why are there so many kinds of soap?

Mr. Bray: We don't recommend so many kinds of soap. Obviously, we know that no one type of soap can be considered perfect for every textile process. However, it is our firm belief, after a considerable amount of observation and testing throughout various textile applications, that sodium oleate is the most generally useful of any type of soap. In other words, it does better in more processes than any other type of soap that we have ever investigated. Tallow soaps have their distinct uses. For example, in the average case, tallow soap is probably the best for soaping dyed cottons. On the other hand, in the majority of processes, sodium oleate is preferable. It depends entirely upon various conditions of operations, quality of goods, type of dyestuffs, etc.

Mr. Burnham: What soap would you recommend for soaping real dirty cloth?

Mr. Bray: That would depend upon further consideration. That material could be scoured as efficiently with a sodium oleate as with a tallow soap, especially if you were operating at lower temperatures. On the other hand, other factors might influence the choice.

Mr. Burnham: If you have a high acidity there in addition to dirt after carbonizing, wouldn't it have to be neutralized and scoured?

Mr. Bray: The acidity should be taken care of by controlled alkali addition, preferably before the soap is brought into the operation.

Mr. Leitch: In the fulling of cloth, what is the highest concentration of Oleate Flakes necessary for the hardest fulling? Is there any point beyond which it is useless to go?

Mr. Bray: That depends primarily upon the amount of oil and dirt in the cloth. The quantity of soap added must be sufficient to emulsify the oil and dirt and leave enough over for adequate softening and lubrication. A very dirty piece of goods will take a high concentration, while a relatively clean cloth can be handled with a low concentration. You can easily handle in the mill a solution containing as high as 16 ounces of Oleate Flakes. That is about as high as it is practical to go. I recall one large mill that customarily uses a solution containing 12 ounces of Oleate and 6 of soda ash per gallon. That is one of the fundamental advantages of the low titer soap—that you can handle higher concentrations. If you tried to work with a solution of 12 to

16 ounces of tallow soap, it would be like rubbing a brick into the cloth.

Mr. Claflin: Have you ever done any work on the difference in the alkali in the soap? For example, potash palmitate or stearate instead of soda. Do you get a greater solubility than with sodium?

Mr. Bray: You do increase the solubility of the soap by making it with a potash base rather than a soda base. However, careful investigations have found no advantages whatever in using a potash soap instead of soda soap. The differences in solubility are quite marked between tallow or palm oil soaps with soda and potash bases. As we come down the scale of titer, the difference in solubility becomes less. When we use oleic acid as a soap base, we find no practical difference between the soda and potash product. For example, a 50% solution of Oleate Flakes has characteristics very closely corresponding to those of potash red oil or olive oil soap. It forms a pasty jelly-like consistency.

Several years ago, we carried on an extensive investigation to discover the reasons for the preference for potash soaps in some textile applications and to determine whether or not they really were better. The results show without any doubt whatever, that there is no advantage to using potash soap.

Mr. Claflin: How low in titer is it advisable to go? For example, abroad they use large quantities of linseed oil soap, but it has never come into use here, although I think it would come lower in titer than the average oleate.

Mr. Bray: The titer of linseed oil is about 16°C. This is several degrees higher than a good commercial sodium oleate. A more important point is the iodine value. For linseed oil, this is extremely high, running between 180-190. Linseed oil is classified as a drying oil. You are familiar with its drying action in paint. Now that drying effect is carried over into the soap. If any linseed oil soap is left on a fiber, it will harden through oxidation to form a stiff or gummy coating on the fiber.

Mr. Claflin: In America, there is a prejudice against linseed oil soap, but in Germany I am very sure they use very large quantities of linseed oil in soap.

Mr. Bray: We feel that the prejudice that you speak of against linseed oil soap is based partly on its high cost and partly on the fact that it gives trouble in use. Any soap with a large content of fatty acids more highly unsaturated than oleic acid will give trouble in processing.

Dr. Chapin: I understand that to avoid high iodine number, your company goes to the expense of hydrogenating its cotton seed oil before making it into soap.

Mr. Bray: If cottonseed oil is made into soap, it should be hydrogenated. Of course, there is more or less cottonseed oil foots soap used that is not hydrogenated, but on the grounds we have been discussing, we don't consider that a wholly suitable soap for textile processes.

Dr. Chapin: As regards the kind of alkali can you not go further by making ammonium soap instead of potassium soap, as in addition of ammonia to washers to loosen up fulling soaps?

Mr. Bray: We did some work along that line in the rinsing of high grade worsteds before piece dyeing. It had been the custom in that mill to rinse for about 15 minutes after soaping, then fill up the washer and add ammonia, run this bath for a few moments, discharge it and continue rinsing.

We studied the whole procedure, making various tests including periodic extractions on samples of cloth removed during the rinsing process. In all cases, the cloth was rinsed until it showed no pink discoloration when phenolphthalein was placed on it.

From the extraction test, we found that the soap rinsed out faster when we left out the ammonia. From the color indication, we learned that it took less time to remove the alkalinity when no ammonia was used. From both standpoints, we found it preferable to rinse without ammonia.

Mr. Draves: As proof of the fact the linseed oil oxidizes on the fiber, if you leave ordinary soap in the textile material it wets out more readily even than if it is not present. If you leave linseed oil in the fabric, it will be resistant to water. That is proof that the linseed oil must oxidize. In regard to Mr. Christison's remark, I would like to ask him if he has tested the carbon tetrachloride after extraction. Our experience has been that it hydrolizes and develops hydrochloric acid.

Mr. Chapin: This may have something to do with its ability to dissolve soaps.

Mr. Bray: If it developed hydrochloric acid, it would raise the yield on extraction because it would tend to decompose any soap present and the resulting fatty acid would be extracted.

In connection with the European use of linseed oil, I learned an interesting thing this summer. I had the opportunity of seeing something of European textile conditions and I was astonished to find that linseed oil is a favorite oiling material for rayon. Naturally, it presents quite a problem in scouring to remove the hardened coating so that dyeing can be satisfactorily done. The rayon must be soaked in alkaline baths to remove the hardened linseed oil.

Mr. Claflin: In regard to linseed oils, I noticed the soap over in Europe washed my hands cleaner than any soap I had ever handled.

Mr. Christison: About Mr. Draves' remark, I think that is a reason why carbon tetrachloride might give a better indication than the ether. I think with the tetrachloride it might hydrolize and the soap left in the wool migh remove the acidity that was developed and I still

think the tetrachloride extraction might give more information than the ether. The combination of the two might give more information than either one used separately. You take ether and acidify it with acetic acid you also get a different effect than you will with neutral ether, and I think that it is fairly comparable with the tetrachloride extract.

Mr. Bray: Why use acidic material if you want to get the residual grease content? In the ether extract our aim is to remove wool grease, spinning oil and such fatty materials as we have been trying to remove by scouring. If you add acidified material, you decompose such soap as is there and you remove a combination of oil and fatty acid. If you want to get a total extract of the material, you can do that with alcohol. Alcohol extraction on a textile fabric will remove both oil and soap.

Mr. Christison: If you are making an extraction in order to determine the cleanliness of the wool, then the ether extraction doesn't show it and the use of carbon tetrachloride or the use of acidified ether I should think would be desirable. If you have cloth and you want to check up the cleanliness, the soap that is left in there may be a trouble maker.

Mr. Bray: If you want to determine the soap, that can be easily done in other more dependable ways.

Mr. Christison: That is a very desirable thing to do. How would you recommend going about it. You use your ether first, then how about the soap?

Mr. Bray: We use ether first to remove the oil and follow with alcohol to get the soap. The alcohol extract can be analyzed to determine the soap itself.

Mr. Christison: If you extract with ether for several hours and with tetrachloride for eight hours, then follow with alcohol, you can get a .1 to .6% after all that extracting. That would indicate one of two things, that either your tetrachloride extraction did not take all the residual soap or the alcohol does take out the residual substances. My opinion is the tetrachloride does remove all the soap and the soap is soluble enough to accomplish that purpose and it is my opinion that the material removed by the alcohol is a wax, some part of the wool grease and has nothing to do with the soap or the grease in there. The reason I think so is because the material that is extracted by the alcohol after the ether extract and after the tetrachloride extract has no ash and shows no alkalinity and for that reason I believe it is a wax rather than a soap. I grant that if you should use ether first and then alcohol you would remove soap and that material that I am calling wax at the same time, but I think if you should use ether and do as you say, remove the grease, then the tetrachloride woulld remove the soap and the other residue, alcohol soluble, about .6% I think is wax and not soap.

Mr. Hayes: May I offer a suggestion about carbon tetrachloride as a soap solvent. Last week we had to analyze the size on some twine. Happening to be low on ether, we used carbon tetrachloride. By long continued extraction the twine was slightly burned (7 hr. continuous heat on Soxhlet apparatus). The twine was tendered at the burnt spots. Evidently in the presence of the natural water of the fiber CCl_4 does hydrolize and develop hydrochloric acid in twine. One would expect under such circumstances to remove soap by dissolving the fatty acid hydrolized from the soap by HCl. The twine, afterwards extracted with alcohol, actually yielded an extract, from which, when acidified, an ether soluble oill separated.

We concluded therefore, that carbon tetrachloride, although it may remove some soap, does not completely extract it.

Mr. Bray: My feeling would be that carbon tetrachloride which is not neutral, cannot be entirely depended on. It may react with the wool in one way or another. As to the extent of its reaction or the material that it removed, conditions would vary the extent of hydrolysis, if that is what takes place, not only would the carbon tetrachloride remove things we don't want removed, but the result would be variable and not at all dependable.

Mr. Leitch: I'd like to suggest that the selection of ether that we use, also carbon tetrachloride or any other solvent, has to be carefully made. Ether often contains more alcohol than it should and carbon tetrachloride varies a great deal. Some of it is not fully chlorinated.

JANUARY MEETING, PIEDMONT SECTION

THE January meeting of the Piedmont Section was held at the Poinsett Hotel, Greenville, S. C., on January 28, 1933. The technical session was held in the afternoon, at which the following papers were presented:

"Uses of SO_2 in the Textile Industry," by A. K. Scribner, Virginia Smelting Company, Norfolk, Virginia.

"Metal Spraying," by Edward F. McCrady, Greenville Steel & Foundry Co., Greenville, S. C.

"The Selection and Testing of Rubber-Covered Rolls for the Textile Industry," by Charles P. McHugh, Manhattan Rubber Manufacturing Division of Raybestos-Manhattan, Inc., Passaic, N. J.

Lengthy discussion followed each paper and a great deal of worthwhile information was brought out in the discussions. Mr. McCrady had all the necessary equipment for spraying the various metals on other surfaces set up in the room, and made a very interesting demonstration of the usefulness of this equipment for coating textile dyeing, bleaching, and finishing equipment with whatever metal needed for each specific purpose.

The afternoon session was adjourned and the Sectional Committee held its quarterly business meeting, at which Chairman Thompson presided.

The following business was transacted and passed by the Sectional Committee and later approved by the Piedmont Section at the short business session held during the Quarterly Dinner.

1. At all future meetings of the Piedmont Section, there be kept a register and all members and visiting non-members register and at the same time purchase the necessary tickets for dinner that follows.
2. That non-members attending future meetings of the Piedmont Section be charged fifty cents (50c) each, over the charge for Association members.
3. That our Chairman, A. R. Thompson, Jr., serve as Councilor on the National Council of the Association.
4. That the officers and members of the Sectional Committee serve as the Membership Committee for the remainder of this administration.

The quarterly dinner was held at seven o'clock in the Main Dining Room of the Hotel at which Chairman Thompson was toastmaster.

Mr. H. H. Willis, Director of Textile Department, Clemson College, addressed the Section on the subject, "Place of Technical Men in the Textile Industry."

Mr. W. M. McLaurine, Secretary, American Cotton Manufacturers Association, presented an inspirational address, which was thoroughly enjoyed by all attending.

Plans are being made for the Spring Meeting, which will be held in Greensboro, N. C., in April, probably on the 15th. Definite date will be announced later.

There being on further business, the meeting was adjourned at 10:00 P. M.

Respectfully submitted,

HUGH PUCKETT,
Secretary.

Sulfur Dioxide in the Textile Industry*

By **A. K. SCRIBNER**
Virginia Smelting Company, West Norfolk, Virginia

SULFUR dioxide—with the chemical formula SO_2—has been known for many years and is undoubtedly familior to all of you. Liquid sulfur dioxide was first produced on a small commercial scale in this country about eighteen years ago. This product today is an important chemical in the textile industry, and its use is spread among a diversified number of industries. It is used in tanning, preservation of foods, treatment of city waters, production of sulfites and bisulfites, and as a refrigerant in many of the successful household refrigerators. This last use might be considered important to the textile industry because you have a large number of water coolers, etc., in your mills.

Briefly, our manufacturing process is as follows:

Sulfur from Texas is burned in a Glenns Falls Rotary and the dilute sulfur dioxide gas produced is passed through a series of scrubbers, forming a one to two per cent SO_2 solution. This solution is boiled in a so-called stripping tank operating at a vacuum and producing a wet SO_2 gas of about 98% strength. Four stages of compression with proper inter-cooling discharge wet SO_2 gas at 120 pounds gauge to our drying system. Here by using only the physical properties of liquid sulfur dioxide we reduce the moisture from 10,000 p.p.m. to 100 p.p.m. for commercial work and 10 p.p.m. for refrigeration. This pressure and subsequent cooling liquefies the gases. The liquid, after analysis, is charged into the containers of trade, which hold 5, 10, 35, 150, 2,000 and 40,000 pounds. All containers are doubly weighed and those being prepared for refrigeration work are twice tested by chemists.

Let us turn now to some of the mill processes in which sulfur dioxide is actually being used today, first considering the bleach house.

SO_2, when added to water, produces sulfurous acid, a solution having acidic properties plus the reducing values of SO_2. If soda ash or caustic are also present the pH of the resultant solution is much higher but the full reducing power of SO_2 is not affected. When an oxidizing agent such as an alkaline sodium hypochlorite is added to an SO_2-bearing solution, the alkali is at once partially

*Presented at meeting, Piedmont Section, January 28, 1933.

neutralized and the active chlorine completely changed to ordinary sodium chloride or salt (NaCl).

$SO_2 + H_2O = H_2SO_3$; $+ NaOCl = H_2SO_4 + NaCl$; $+ 2NaOH = Na_2SO_4 + NaCl + 2H_2O$.

The sulfurous acid is converted to sodium sulfate, sodium bisulfite, or sodium bisulfate, depending upon the alkali present in the hypochlorite.

Instead of mixing the two solutions, a piece of cloth can be dipped in a 1° Tw. or 2° Tw. chemic solution and immediately dipped in, let us say, a solution of about 0.025% SO_2 in water. On removing the cloth and looking for free Cl the test will be negative, and at the same time a check for alkali with Methyl Orange will show presence of hydroxyl ion. Now repeat, but rinse the cloth after the chemic, and on completing the experiment you will find Cl absent and a faint pink to Methyl Orange which is a pH of about 4.3.

This is really the antichlor cycle in the bleachery when using liquid sulfur dioxide and from it we obtained the well defined properties of an antichlor.

Primarily, the compound must remove all active chlorine and neutralize all free alkali quickly, economically, and safely, and it must be used in such concentrations that goods leaving the pit may be freed of the antichlor with almost no washing. These characteristics partially control the all-important problem of tendering or damage to fabrics while in process.

The secondary considerations involve the ability of the antichlor to penetrate to the chemicals in the seams and warp of heavy fabric; the maintenance of suitable concentrations by a simple continuous feed combined with freedom from trouble if variations in flow are large and, finally, the economies due to reductions in labor, wash water and wear and tear on the goods.

Perhaps one of the oldest white sours is sulfuric acid, and as I remember it, the box used to average 1° Tw. or 1% sulfuric acid. This sour actually breaks up the hypochlorite, drives off chlorine and produces an intense bleaching action during a very short interval. It depends on a strong acid concentration to dispose of the chlorine and this large amount of acid on the fabric must be washed off or tendering will follow.

Sulfur dioxide as antichlor reduces the NaOCl at once and a maximum of 0.025% SO_2 is all that is required for the work. Fortunately, the maximum concentration of SO_2 that you can use without a warning odor is close to 0.025%. Thus these two characteristics allow complete hypochlorite removal, prevent high acidity on the fabrics and give simple control.

The actual ratios of SO_2 to H_2SO_4 figure from 1 to 8 to 1 to 30, depending on the plant and operating conditions. More details on this can be found in AMERICAN DYESTUFF REPORTER, July 20, 1931.

In practice, the cylinders of SO_2 are placed at the sour pits in an upright position. The liquid boils in the container, producing gaseous SO_2 which in turn is passed through control bubble bottles to the sour pit. The initial concentration is usually 0.025 to 0.03%, and after that the flow is maintained at a predetermined rate depending on chemic—rinse—speed—weight of fabric, etc. The experienced operator soon knows the rate of flow required, and without a test of any kind tells by the odor of SO_2 in the antichlor pit and by a Cl check from time to time whether he is getting the results he wants. On a new setup it is well to make a complete study from the chemic to finishing room and determine just how strong the SO_2 must be, how much prewashing is needed, etc. Starch iodide, Methyl Orange and iodine will be ample for the usual test work.

As each bleachery has its own problems and methods, the only way to determine whether one should use liquid sulfur dioxide is to try it. The equipment is merely a cylinder, hose and bubble bottle plus the cooperation of the bleacher.

We next find liquid sulfur dioxide in the dyehouses of mills that use hydrosulfites for dyeing and stripping cotton and wool. Here the use involves a process for the manufacture of hydrosulfite solutions, which contain either zinc or sodium hydrosulfite. The ultimate solutions made in the dyehouse if processed further in proper equipment, etc., would produce hydrosulfite powder. These later steps are difficult and those producing powders have done an excellent job in furnishing them at a reasonable cost.

The use of "hydro solutions" in the mill is simply an *economic one*, and *by that I mean reduced costs in the dyehouse*. The product of the reaction caused by adding liquid sulfur dioxide to zinc dust suspended in water is zinc hydrosulfite. In some stripping work zinc "hydro solutions" have been successfully used but usually an alkali is next added. This precipitates the zinc and leaves in solution $Na_2S_2O_4$ (sodium hydrosulfite) with zinc hydroxide or carbonate in suspension.

For the reduction of Indigo, the springing of the large continuously operated Indigo vats, and the dyeing of vat colors in raw stock or Franklin process machines: The above solution is always filtered and stored in specially designed tanks. The filtrate is clear and alkaline, with the characteristic color of a sodium hydro sulfite solution varying in concentration from 1 to 1.5 lbs. of $Na_2S_2O_4$ per gallon. This solution, when properly prepared, has been kept in laboratory tests for seven days with a loss of less than 4% in strength as determined by the Indigo titration and checked by the ferricyanide test. Practically "hydro" is easily kept overnight with losses of about 5% to 12%. This "hydro" is usually used for the first morning spring. It in no way interferes with the process and represents a very small percentage of the total daily "hydro solution" produced. The equipment consists of

properly designed tanks, pumps and presses. It is not expensive, is easy to operate once the operator is trained, and the upkeep has proven to be low. There are plants operating in the South that were started in 1921, and the record shows that one in particular has never reduced a pound of Indigo with anything but these "hydro solutions" produced in the dyehouse.

The development of vat dyes and the rapid increase in their consumption naturally increased the demand for hydrosulfites. As the demand grew large enough, it was found that hydrosulfite solutions properly prepared could be used without filtration for vat dyeing. At first the specially prepared unfiltered "hydro solutions" were used on the jigs, then in the booster box of a continuous machine and finally for the reduction of the vat feed itself.

The "hydro" used for this work is tested with disulfonated Indigo, or ferricyanide. In dyehouse practice the Indigo works very well, especially if the titration is carried to the orange yellow endpoint. Practical tests with "hydro solutions" indicate that it is possible to introduce them into the regular formulae of the dyehouse, with possibly a slight adjustment in volume to start the mix and if desired a saving in alkali.

The equipment for this process is not complicated and up to now the evidence is that the "hydro solutions" are satisfactory.

Everything I have told you about these applications of SO_2 is, of course, theoretically true, but the textile chemist or the practical bleacher or dyer in his endeavor to do an econmical job for his mill has made successful the daily practical application of these uses, and in closing I want to pay a tribute to these men behind the scenes of so many fabrics produced today.

I thank you.

Metal Spraying*

By **EDWARD F. McCRADY**
Greenville Steel & Foundry Co.

GENTLEMEN: In regard to Metal Spraying, my Company, the Greenville Steel & Foundry Company, of this city, purchased and installed this equipment five months ago, believing from what we could learn here and there that it would be of great use in fighting rust and stains for the textile industry of this section.

We understand that this metallizing or spraying process has been used successfully in Germany for about twenty years. Since the war the equipment has been manufactured in this country and is, therefore, now coming into prominence in the United States.

Metallizing is used for four general classes of work:

First, coating equipment for the purpose of resisting rust and corrosion caused by acids, the elements, etc.

Second, coating furnace parts, etc., to resist heat corrosion.

Third, building up worn and undersized parts.

Fourth, decorating and architectural effects.

Today, we will speak only of the first use, that of Resisting Rust and Corrosion in which we believe you will be most interested.

The process consists of spraying at a high rate of speed molten atomized metal upon a surface. The surface to be covered is first sand-blasted until it is chemically clean and of the roughness of fine sand paper. The sand-blasting also produces "Key-fasts" which are necessary for the coating to adhere. The bond between the new metal and surface is purely a mechanical one.

The gun as you see is somewhat similar to a paint spray and operates in a similar manner. The metal selected for the coating is fed into the gun in wire form and is pulled through the nozzle at the correct rate of speed by an air turbine which is operated by air from the compressor. Acetylene and Oxygen ignite behind the nozzle and fuse the metal wire. The air blast from the compressor atomizes the molten metal and forces it out at the rate of about 30,000 feet per minute. This impact aided by the "Key-fasts" causes that coating to adhere.

The thickness of the coating per coat varies from about .001″ to .003″, depending upon the melting point of the metal used. Lead and tin for instance cover a great deal thicker than the harder metals such as Monel and Stainless Steel.

For a coating to do the work for which it is intended it must be non-porous. Theoretically two coats of lead or tin will give a non-porous coating but for Stainless Steel it takes eight coats and for Monel, twelve. In our work, therefore, we expect to find this spraying process more practical in the use of soft metals with low melting points rather than with the other metals.

*Presented at Meeting, Piedmont Section, Jan. 28, '33.

Quite often the question of expansion and contraction comes up and we believe from our experience that the interlocking bond between the coating and the surface will take care of the difference, if any, in the coefficient of expansion of the two metals, provided the article coated is not subject to extreme and sudden changes of temperature. If it is subjected to these extreme changes we do not believe the coating will hold.

Our biggest difficulty at present is in securing a chemically clean surface on a piece of equipment that has been in previous use,—especially if the equipment is made of cast iron. In one case it was practically impossible to get out of the pores of a cast iron size kettle the tallow which had soaked in during previous use. In another case the walls of a mercerizer continued to seep what seems to be sulphur. In both of these cases the coating of new metal would not adhere. In such cases, therefore, we would recommend that we furnish a new kettle or tank of new electric welded steel on which a satisfactory coating could be applied.

The coating you will note is of about the same roughness as the sand-blasted surface. If this roughness is objectionable for the purpose used the coating can be polished to any degree of smoothness by rubbing with steel wool or using a burnishing brush. We understand also that polishing closes up the pores and makes the coating more effective.

Another interesting feature of this process is that the coating can be applied successfully not only on metal surfaces but also on wood, concrete, plaster terra cotta and even cloth. The atomized metal is almost cool when it strikes the surface.

We will now light up the gun and give you a demonstration of this spraying process. I thank you.

The Selection and Testing of Rubber Covered Rolls for the Textile Industry*

By **CHARLES P. McHUGH**

The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J.

BEFORE we go into the technical details of the testing and selection of rubber rolls, let us digress for the moment and learn a little about rubber; where it is found and how it is made up into a rubber roll.

Rubber was first discovered by the white man when Columbus discovered America. Columbus is said to have discovered the natives of Haiti playing ball with rubber balls on his second voyage to America in 1493. This material, which would bounce when dropped, was unknown to the Spaniards, and the Indians explained to them that it was made out of the dried and smoked juice of a certain plant, which we now know as Hevea Brasiliensis. This juice we call rubber latex.

We hear but very little about rubber from its discovery until about 1822, when John Hancock of England began to manufacture waterproof fabrics by painting cloth with solutions of rubber gum cut in solvent. The reason for this is that although rubber latex could be used by the Indians of Brazil to make waterproof fabrics and simple rubber articles, it was impossible to ship this material to Europe because it was quite unstable and would become bad in a few days, and no one knew how to use the coagulated and smoked gum such as we know as the crude rubber of today. Although it had been known for years that rubber could be cut in certain solvents such as turpentine, these solvents were very scarce and expensive, and consequently would make the cost of rubber manufacturing prohibitive. About 1819 the coal gas industry had its inception on a large scale in England, with the result that many solvents which are by-products of coal tar became cheap and plentiful. This gave impetus to the manufacture of rubber articles by dissolving rubber gum in coal tar naphthas and using this cement to coat fabrics. However, this industry had but fair success due to the fact that crude rubber is thermoplastic and becomes hard and brittle when cold and soft and sticky when warm. Rubberized fabrics waterproofed with these crude cements become stiff like a slicker on a cold day and soft and sticky like flypaper in the summer, and for that reason were not very popular. Many people saw that if one could overcome this tendency of rubber to become soft and sticky when hot by treating it in some way so that it would be unaffected by temperature changes, it would

*Presented at meeting, Piedmont Section, January 28, 1933.

become a very useful material. Numerous attempts were made to do this, but they ended in disastrous failures. However, Charles Goodyear, a Connecticut Yankee, discovered in 1839 that if you heated rubber, sulfur, and white lead together, that something happened, and the resultant rubber became completely changed in its characteristics, and no longer became hard and brittle on cold days or soft and sticky in the sun, but was pliable and elastic at all ordinary temperatures, a characteristic possessed by no other known material to the same degree, and one which marks rubber as one of the most useful engineering materials possessed by man today. Goodyear also discovered that if you added an excess of sulfur to the rubber and heated it for a long time, the rubber changed from a soft pliable material to a hard, strong and horny material, known as hard rubber or ebonite. These two methods of treating rubber are the foundations on which the whole rubber industry is built. The modern chemist has made modifications, and has learned to control these reactions so as to turn out much better products, but he has not fundamentally changed them.

After the discovery of how to vulcanize rubber, its uses increased enormously. The writer had the good fortune to lay hands on a book published by Charles Goodyear in 1858. In this book Mr. Goodyear shows pictures and comments upon articles then being made of rubber. There are pictures in this book of practically every article which is made of rubber today, except automobile tires. He even talks about rubber rolls. I have also found other records, which show that rubber rolls were first made commercially in this country about 1865, and that one company alone by 1890 had made twenty thousand rubber rolls.

Rubber Process

Now that we know something about rubber and its history, let us see what process rubber goes through before it finally becomes a rubber roll, such as you receive at your mill.

Rubber comes from a tree somewhere in Sumatra, Borneo, or Brazil. It is collected by natives, who cut slits in the bark of the tree and collect the milk-white liquid which oozes out. This milk-white liquid is known as rubber latex. The rubber particles, which are suspended in this latex, like butterfat in cow's milk, are separated from the watery material by coagulating with a weak acid, such as acetic acid. This coagulated rubber is then thrown on rubber mills and washed and sheeted out, after which it may be smoked, which gives it its dark brown color. It is then packed in boxes and sent to us in America.

When we receive the rubber at the rubber factory, we open the cases in which it comes and inspect it. We then mix several lots of rubber together and blend them on a mill so as to make sure that we eliminate any variations which might be present due to some variations in any one lot of rubber coming from any one supply. All rubber used in the manufacture of our rubber rolls comes from our own plantation in Java. It is so necessary that rubber which is to be used in rubber rolls should be of as high a quality as possible that we maintain these plantations so that we can control the quality of our rubber from its very source.

This so-called "broken down" rubber then goes to the compounding room, where it is mixed with various compounding ingredients. These ingredients are all sifted before use so as to make sure that no foreign matter gets into the compound. The ingredients which are added to rubber give it the different characteristics which are required of it when it is vulcanized. The compound for a soft roll to be used as an inking roll on a printing press would have different ingredients in it than would a roll for a machine finishing textile fabrics. Also, a roll which is to be used with acid must be compounded differently from one which is to be used in water only.

After mixing, the compound is put through strainers to make doubly sure that all foreign material has been eliminated.

Before the compound can leave the mixing room for the next operation, it must be tested by the factory control laboratory. If it can pass the laboratory test satisfactorily, we are certain that when this particular batch of stock is made up into a roll it will be satisfactory. If the test is unsatisfactory, the compound is rejected for use as a roll stock. We have to do this because the risk of using poor stock is too great. Many large paper rolls are covered with more than a half ton of rubber compound, and to find out after a roll has been made up that the compound was not right would be just too bad.

From the mixing room the compound goes to the calender room. Here the slabs of rubber compound are again put back on mills in order to soften them by mechanical mixing and working. When the compound has softened to the correct state, it is rolled out into sheets by passing it through a calender. This calender is very similar to a three-rool calender as used in the textile industry. In order to build these sheets up to the correct thickness for roll building, it is necessary to pass them several times through this calender. The calendering of rubber compounds for use in roll making is a very difficult operation because if air, moisture, or foreign material should get in between the plies, it would cause blisters or other defects in the finished roll.

From the calender room the roll of sheet rubber goes to the roll department to be made up into a roll.

Let us forget about that roll of sheet rubber which we have been following through the calender room for the moment and turn our attention to the iron center which is the foundation of a rubber-covered roll. When a roll

comes to us for covering, we either receive an old roll with a worn-out rubber cover or a new iron center right from the foundry or the machine builder. These iron centers are the foundation of a roll, so they should be well made; a poor iron center will ruin a roll. A good iron center will have the following characteristics:—

1. It will be strong enough so that it will not flex under the load.
2. It will have an even wall thickness all around, so that there will not be any weak spots.
3. The center will be correctly balanced. A roll which is out of balance will pound, and ruin the cover. On slow moving rolls it is sufficient to have the rolls statically balanced, but rolls moving at high speed must be dynamically balanced.
4. The rolls should be made out of a good grade of cast iron and should be free from blow-holes, sand-holes, imbedded scale, and hard spots.

A good center may cost a little more, but it is the cheapest roll in the end. It is a purchase which you only make once, and it pays to make a good one. It pays you by eliminating the possibility of unexpected breakdown and loss of production, and it helps us in many ways in our effort to turn out satisfactory rolls.

Covering Rolls

When we receive a roll for covering, the first operation, if it is a new one, is to boil it out; that is, we put it into a vulcanizer and heat it up with steam to a high temperature. We do this to remove any absorbed gases in the cast iron, any oil, or any foreign material which may be present in the casting, and which might be decomposed by the high temperatures of vulcanization and give off a gas which might prevent a perfect adhesion between the rubber cover and the metal center. If the roll is an old roll, back to be recovered, we simply strip off the old cover with a tool.

The iron center is now ready for threading or sand blasting. We do this to roughen up the surface of the iron center so that the rubber has a perfectly clean surface to fasten itself to and also to remove any scale which might prevent good adhesion. The service required of a roll determines the method of preparing the surface.

The roll is now ready for covering.

The first operation in covering a roll is to cement it. To cement it, we brush on several coats of a special rubber cement which acts as a binder between the rubber cover and the metal. This is followed by a layer of special binder compound. This binder compound is the same composition as the cement. It is a whalebone-like material which adheres tenaciously to the metal and to the rubber. It also acts as a cushion between the softer resilient rubber and the hard rigid metal and tends to lessen the stresses which would otherwise be set up if a soft, resilient material like rubber should be attached directly to a rigid material like iron. This method of fastening our rubber to the iron centers gives us an adhesion of over 1,000 lbs. per sq. in., which is adequate for any service. The thickness of this layer of binder material varies from just a skim coat on rolls which are doing light work to 3/16 inch on rolls doing heavy duty.

We now apply the face or top compound, by fastening one end to the base compound and rolling on one ply of stock. We then cut off the rubber sheet and roll this sheet down tightly so as to make a perfectly concentric layer of rubber, stitching down the seams so that we get perfect adhesion. We continue this operation, laying on each ply of rubber and rolling and stitching it down in the above manner until we have built up the roll to its proper size. As each ply of rubber is put on, the roll is carefully rolled down with iron rollers to make sure that there is perfect adhesion between all the plies and that the roll is perfectly concentric.

Now that we have built up the roll, the next operation is to tightly wrap it with cotton tape. We do this to make sure that all the layers or plies of rubber are tightly pressed together and to prevent the rubber from sagging when it is softened by the heat of vulcanization. Uncured rubber is a thermoplastic material, and consequently it tends to soften with heat, and also expands when heated. We take advantage of these two characteristics when we wrap a roll. To wrap a roll, we wind many turns of cotton tape on it by revolving it. This tape is strong, and is wound very tightly so that there is practically no "give" to it. When the rubber softens and expands, it exerts a pressure against this tape, which in turn compresses the rubber. This pressure compresses the different plies of rubber into one solid, homogeneous mass of rubber.

The roll is now ready for vulcanization. Vulcanization is the name given the reaction which converts soft, sticky rubber into tough, elastic, resilient, and tackless rubber. Rolls are vulcanized by putting them in large iron cylinders or tanks with removable heads. These cylinders are similar to kiers in a bleach house placed in a horizontal position. They are fitted with steam pipes so that steam may be admitted to heat them. The time necessary to properly vulcanize the rubber roll varies from six to fifteen hours, depending on the size of the roll, the thickness of the rubber cover, also on whether the roll is solid, cast hollow, or is a thin pipe roll, and whether the rubber cover is soft rubber, medium, or hard rubber.

After the rubber rolls have been vulcanized, they are taken out of the vulcanizers and the cotton wrappers removed. They are now ready for the finishing operation, to true the roll up and grind it down to its correct size. This is done by revolving the roll in a grinding machine and ginding its surface down with emery wheels. The roll is first rough cut with a coarse stone down to correct size, then finished with a fine stone.

In the case of large rolls it is usually necessary to crown them in order to allow for the spring in the body of the roll when it is suspended from its journals. Otherwise there would be too much pressure on the ends of the rolls and no pressure on the center. This crowning is done by a special crowning device on the grinding machine. The crown put on a roll varies from a few thousandths of an inch to probably one hundred fifty thousandths, depending on the size of the roll and the work it must do.

Textile Rolls

Now that we have finished our roll, we must test it. All rolls before shipping them to the customer are thoroughly tested in our plant.

They are tested for size by calipering them with a micrometer. Some of our rolls are ground down to size with a tolerance of plus or minus .002 inch. If the roll is crowned, the crown is checked to see that it is uniform with a crown indicator micrometer.

The roll is tested for hardness or density with an instrument known as a plastometer. The plastometer is the instrument which is universally used in the rubber industry for determining the hardness of rubber rolls. This instrument measures the depression made in the rubber in hundredths of a millimeter by a ¼ inch or ⅛ inch steel ball under a load of one kilogram. A ⅛ inch ball is used to measure plastometer reading from 0 to 100. For rubber which is softer than 100 plasto we use a ¼ inch ball and report our reading as, say 140 plasto with a ¼ inch ball. We use a ¼ inch ball for plastometer readings of over 100 because we have found that following this procedure we are able to check our reading more accurately. When a ⅛ inch ball is used on very soft rubber, it is apt to give incorrect readings, because the ball imbeds itself in the rubber and there is apt to be a considerable drag on the side of the ball holder which will cause inaccuracies in the reading.

There are other instruments used for measuring the density of rubber, such as the durometer and densimeter, but we do not recommend these for testing roll covers because, in principle, they measure the depth that a blunt needle penetrates the rubber under a spring load. Springs are always bad on measuring instruments. The human factor is also important with these spring type instruments. One can get a considerable different reading with any of these instruments depending on how hard one holds the instrument against the rubber to be tested. For the above reasons we use the plastometer for measuring the hardness or density of our rolls, as this instrument practically eliminates the human factor and depends only on gravity for its correct reading.

The Selection of Rolls for the Textile Industry

Regardless as to what kind of a machine a rubber roll is to be used on, rubber rolls are used for but two purposes in the textile industry, first, as a squeeze roll, and secondly, as a carrier roll. Textile machinery is known by many different names, and there are many different opinions as to what density of rubber is most suitable on a roll for any one type of machine. This is due to the fact that each plant is running a different type of goods or that their process is just a little different from the next fellow's. Because of these differences in processes in the different plants, it is difficult for me to even know how to begin to talk about the selection of rubber rolls for use on textile machinery other than in a very general way. The best way to approach this subject will be to let us follow the grey goods through a hypothetical bleachery and dyehouse and stop for a moment at each machine and discuss its rubber rolls.

First the grey goods are received at the bleachery and the ends are sewed together. The goods then go through the singeing machine. This machine usually has two rubber rolls on it for squeezing out diastofor. The top roll is usually of medium softness and the usual practice is to use a roll with a plastometer reading of 50-60 and a bottom roll with a plasto of 10-20. These densities are not really important and can be varied to suit goods going through the various mills.

From the singeing machine we follow the goods through the steeping bins to the washer. This machine may have either wood or rubber rolls. If rubber rolls are used, they are of hard rubber of about 10 to 20 plasto. I shall discuss these rolls at greater length later.

From the washer the goods go to the kiers.

Coming from the kiers, the goods go to another rope washer. This is usually 120 inches long and may have wooden or rubber rolls. General practice today is to use rubber rolls, as they are immuned to acid waters and do not shrink, warp, or split when not in use during shutdowns, the way wooden rolls do. They give excellent service—there are many rubber washer rolls still in use today which were manufactured over ten years ago. When rubber rolls are used, the machine may be of the two or three roll type. If it is a two roll type, it has only a top and pit roll; these rolls are covered with hard rubber with a plasto of from 10 to 20. The three roll type of rope washer is the same as a two roll washer except that it has a softer squeeze roll mounted above the top roll. This roll is much softer and has a density of about 40-50 plasto. This is necessary because the function of this roll is to squeeze the goods as they pass in rope form through the nip.

From the long washer the goods go through an 18-inch squeezer to squeeze out the surplus water. A bleach house squeezer consists of a pair of heavy rolls. Both

rolls may be rubber or one may be brass. The coverings usually used for bleach house squeezers call for a hard bottom roll with a plastometer reading of 5-15 and a softer top roll with a plastometer reading of 60-70. These densities are only given as ones generally used. Many plants use softer rolls, testing 70-80 or even 90-100 plastometer reading in order to get the results they desire. These rolls probably receive more punishment than any other form of rubber roll covering. The goods go through in rope form, and the rolls usually operate with heavy loading. In most cases the goods are allowed to run through in one place, and they soon wear a groove in the roll. Sometimes the center of the roll is completely worn out when the ends show but little wear. The thought occurs to the writer that it might be a good idea to put a movable guide in front of these rolls so that the path of the rope as it goes through the squeezer could be changed from time to time in order to distribute the wear on the rolls and thus increase their life.

It might also be a good idea here to say something about the care of squeezer rolls. Squeezer rolls, for some reason, seem to get damaged by cutting due to hard foreign material going through the nip. Even a small cut in a rubber-covered roll means that the roll will be quickly destroyed, for the simple reason that as soon as a cut appears in the roll, it is filled with water. When the cut filled with water passes through the nip, the top of the cut is sealed off by the surface of the upper roll or by the rope. The rubber is then compressed. The water in the cut can't be compressed—water is incompressible—so in order to escape, it must tear the rubber. As the cut becomes larger, more water comes in and tears the rubber still more. In a very short time this working of the water in even the smallest cut will work its way down through the rubber and cause part of the rubber cover to strip right off the roll. The only way to stop it is to seal the cut immediately, but before you attempt to do this, be sure that the cut is dry. Small cuts can be easily sealed with rubber cement, such as is used for repairing inner tubes, which can be obtained at any garage, or with the regular sealing compound supplied for mending cuts in rubber tires. It is only necessary that these cuts should be filled up so as to keep the water out.

Getting back to the rope where we left it before we started to talk about squeeze rolls, we find the goods going to the acid squeezer. This squeezer is similar to the water squeezer except that the sides of the roll are rubber-covered to prevent the iron centers from being attacked by the acid. Many plants have all their squeeze rolls rubber-covered on the sides so that the water squeeze rolls and the chemical squeeze rolls are interchangeable.

Leaving the acid squeezer, or nip, the goods go through many operations and machines in which rubber rolls are used, such as washers, chemical squeezers, anti-chlor squeezers, and more washers, until finally they reach the water mangle and the drying cans, from which they go to the white goods storage. In these many operations rubber rolls enter into the picture only as they are used on the rope washers, squeezers and the water mangle.

The water mangle is the last machine in the bleach house which I shall talk about. This machine is used to mangle the goods and to extract water from them in the open form just before they go over the dry cans. Water mangles usually consist of five rolls. Two are made of chilled iron and three are made of compressed cotton or of composition material. Sometimes these three rolls are rubber-covered. The only advantage in using rubber-covered rolls is that rubber is resistant to acid. If rubber covers are used, one must not use excessive pressures, that is, pressures exceeding 500 lb. per inch of nip, when using a rubber-covered roll at least eighteen inches in diameter. Small rubber rolls should be used with correspondingly less pressure. The hardness or density of the rubber covering which should be used on a water mangle varies with the expected weighting. An eighteen inch roll to be used with a maximum weighting of 500 lbs. per inch would necessarily take a hard cover, of about 15-30 plastometer reading, whereas a roll of the same size to be used with a maximum loading of 300 lbs. per inch would take a softer cover, of say 40 to 50 plastometer reading.

Once the goods have left the bleachery there are so many different processes through which they may be put that it will be quite impossible for me to even attempt to follow them. Instead, I am simply going to attempt to pick out the more usual machines and say something about their rubber-covered rolls.

We shall begin with the dye jig. Rubber is an important part of this machine. In many cases the vats are made of steel and are rubber lined with either soft or hard rubber. The beam rolls are usually hard rubber.

Then there is the dye padder. It consists of a dye vat through which the goods pass and a set of three squeeze rolls. These rolls can be made of wood, brass, or rubber. The usual practice when using rubber rolls is to use a soft top and bottom roll and a hard middle roll. It is very difficult to make any definite recommendations for a dye padder, because the correct density of rubber rolls for this machine depends entirely on the kind of goods which are being run and the amount of dye which one is trying to put into them. For general work, such as is being run in the average bleachery, it has been found that a top roll of plasto 35-45 with a hard bottom roll of plasto 5-15 gives satisfactory results. Where one is running shade cloth or other cheap goods, where it is only necessary to dye the cloth on the surface, a softer roll is used. For example, a top roll with a plasto of 70-75 and a hard bottom roll with a plasto of 5-15 might be used.

After printing and dyeing, the goods are usually passed through a soaper to wash out the surplus chemicals or for

some special after-treatment. The ordinary soaper has many compartments, with a set of rubber squeeze rolls between each compartment. The usual practice of soapers is to use a top roll of from 40 to 80 plasto and a bottom roll of from 10 to 20 plasto, depending on the goods being run. When ordering rolls for soaping machines, the bleachery should tell the rubber manufacturer just what chemicals are going to be used in the various compartments of the soaper, also at what temperature and concentration these chemicals are being run. The usual rubber roll cover is made to give you reasonable service with most all chemicals used in the industry. However, there are certain chemicals which have a very deleterious effect on rubber, and consequently shorten its life. By proper compounding, the rubber chemist is able to materially retard this destructive action, so that rubber products used in this service will give fair life. Consequently, when you contemplate the use of special acids and chemicals, this information should be passed along to the rubber manufacturers, so that they can give you the best roll covering for the job.

After leaving the soaper, most goods are sent through a starch machine of some kind. These machines go under such names as a "Quetsch," "Starch Mangle" or "Tommy Dodd," depending on the kind of goods that are being run. Every bleachery superintendent has his own ideas as to what should be the correct density of hardness for these rolls. I will try to give you some densities, which may be a guide to you in selecting these rolls. These densities, we believe, are the usual ones being used on the average goods.

General practice for starch mangles calls for rolls of a density of 30-45 plasto down to 5-15. Heavy pressures call for harder stocks. You must also use a harder roll with hot starch solutions than with cold starch solutions. What density you should use depends on the results you wish to obtain. If you are using heavy pressure to drive a hot starch into the goods, you may need a roll of 20-30 plasto. For the ordinary commercial run of goods using a hot starch solution, a roll with a plastometer reading of 45 will give good results. On the other hand, in order to run light gingham you might need a roll of 5-10 plastometer reading.

Another form of machine is the "Tommy Dodd." When using hard rolls on this machine, it is important to keep foreign material out of the starch, otherwise you will have trouble due to grit getting back of the knife and cutting a groove in the roll. When using rolls of softer density, of say 60 plasto or softer, this is not so apt to happen, as the rubber will yield and let the foreign material go through.

The latest field of conquest for rubber products in the textile industry has been the development of rubber furnisher rolls for the printing machine. These rolls are made by either molding or cutting teeth in a light rubber roll so as to give it a very rough surface, like a brush with short stub bristles in it. This roll has many advantages over wooden rolls, as follows:—

It requires no lapping.

It is easy to clean.

It is unaffected by the dye and does not crack or warp when dried.

It also seems to act as a comb and picks lint and threads off the goods.

Care of Rubber Rolls

Before closing, let me say a few words about the care of rubber rolls, because, like any other machine tool, a rubber roll requires adequate care if it is going to give good service.

The following hints as to what to do and what not to do to rubber rolls may prove interesting and profitable:—

1. Never let a rubber roll rest on its face. Always support it from blocks by its journals. If a rubber roll is left lying on its face on the floor for any length of time, it will take a "set" and become flat at that place.

2. When any machine on which rubber squeeze rolls are used is not in use, the weights should be released and the rolls lifted, so that the rubber rolls are not under pressure, otherwise they will become flat at the point of contact.

3. Protect rubber rolls from direct exposure to sunlight. Sun is the greatest enemy to rubber goods; it causes sun-checking.

4. When you put rubber rolls away in storage, wrap them in paper and store them in a dark, cool place, preferably in a wooden case, like the one in which they were shipped. Heat and sunlight have a very destructive action on rubber goods. Rubber rolls as we make them today are more resistant to aging than ever before and will give good service even when abused. However, even better service may be obtained from these rolls if you will treat them right.

5. Keep rubber rolls away from grease and oil. See to it that oil from the bearings does not get onto the ends of the rubber cover.

6. Inspect your rubber rolls often and don't keep a worn or defective roll on a machine longer than is necessary unless you want to have trouble.

7. Patch immediately all cut rolls. Nothing will ruin a roll any faster than a cut.

8. When a rubber roll needs grinding, be sure and grind it sufficiently so as to get down below any cuts or checks, otherwise these cuts will continue to grow down deeper, and it won't be long before you will have to regrind the roll again.

If you should need any information concerning the proper methods of grinding and polishing rubber rolls, we shall be only too glad to supply it to you if you will write to us.

SEVENTY-NINTH RESEARCH COMMITTEE MEETING

THE Seventy-Ninth Research Committee meeting was held at the Chemists Club, New York City, January 27, 1933. The following members were present:

Louis A. Olney, Chairman; Robert E. Rose, Wm. D. Appel, Wm. H. Cady, Harold M. Chase, Howard D. Clayton, Carl Z. Draves, Ephraim Freedman, A. Newton Graves, Walter E. Hadley, Jos. F. X. Harold, Ralph Hart, Hans Meyer, Wm. R. Moorhouse, Donald H. Powers, Walter M. Scott.

The Chairman reported that another allocation of $5,000 had been made by the Textile Foundation to complete Research work already under way and to continue the study of certain developments from this work. He announced that an additional grant of $3,600 for the purpose of studying Textile Printing Pastes had been made and further stated that plans were already under way to form a sub-committee upon the subject of Printing Pastes, and that this committee would to a considerable extent be in charge of this particular research project.

A letter from Heyward F. Lawton, Chairman of the Rhode Island Section was read which recommended the publication in the Year Book of a classified list of special chemical compounds, other than dyes, used in the textile industry. This letter led to extended discussion in which opinions both favorable and unfavorable were expressed. As it was too late to do anything about the publication of such a list in the 1932 Year Book, it was decided to postpone any action either way until the whole matter had been more fully considered.

The Chairman went into some detail in regard to the program of the Research Associates for the coming year and also reported results of the questionnaires upon the subject of suggested research problems which he had recently sent to all members of the Research Committee. He reported further that the results of this questionnaire had been quite satisfactory and that all the questionnaires would be turned over to the Committee on Research Program, for their consideration, it being the understanding that a list of these proposed subjects would be published later in the Proceedings.

Mr. Hart, Chairman of the Committee on Analysis and Classification of Sulfonated Oils, reported that his committee was at the present time working upon the determination of So_3, but that this was not sufficiently completed to make a detailed report. A full report will be published later on in the Proceedings.

Dr. Harold reported that the new committee on Standard Methods of Chemical Analysis and Testing as Applied to the Textile Industry had been formed and the following men had been invited to become members of the committee:

Wm. H. Cady, Harold M. Chase, Carl Z. Draves, Elmer E. Fickett, Ephraim Freedman, A. H. Grimshaw, Henry Green, Ralph Hart, E. H. Harvey, Karl M. Herstein, R. W. Hook, Wolf Kritchevsky, Ralph T. Mease, George A. Moran, Chas. B. Ordway, D. H. Powers, Raphael E. Rupp, Walter M. Scott.

This committee will concern itself with the stanadardization of methods of chemical analysis applied to the field of textiles. Its work will be largely the elaboration of analytical methods for the examination of supplies used in textile processes and the critical examination of the issuing fiber or fabric. Members of the Research Committee and of the Association in general were asked to cooperate with the committee by calling attention to any novelties or improvements in analytical methods or extension of present methods that may come under their personal observation.

Mr. Clayton, Chairman of the committee on Shrinkage of Textiles reported that during the past few months extensive work had been done by their committee and that as a result a revised method of procedure would be published in the 1932 Year Book.

It was definitely decided to hold the next meeting of the Research Committee in Washington, Friday, March 31st.

The meeting adjourned at 5:30.

Respectfully submitted,

A. NEWTON GRAVES, *Secretary.*

CALENDAR OF COMING EVENTS

Meeting, New York Section, March 24.

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Meeting, Philadelphia Section, March 24.

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Meeting, Rhode Island Section, March 31.

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Annual Meeting, Chicago, September, 1933.

AMERICAN
DYESTUFF
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A BALANCED BUDGET AND CONFIDENCE

WE HAVE confidence! Perhaps you think that is a strange statement to make at this time or perhaps you, too, can truthfully give expression to the same thought. And, to our way of thinking, the one element that would definitely start us on the road to recovery is a universally inspired return of confidence. Lack of confidence has raised havoc with our financial and economic institutions the last few years.

You may ask, in what have we confidence? We have confidence in the ability of our federal administration to effect a balanced budget; we have confidence in the imagination, courage and resourcefulness of our citizens and, we might add, all plans for economic recovery rest on the honesty, purposefulness and patriotic public service of our individuals; we have confidence in the various trade associations to act as a force for constructive accomplishment and not merely as an instrument of defense; we have confidence in the sincerity of American business firms, and to those who have so far successfully weathered the economic storm we express the hope that they will give further expressions of confidence to their associates, because the mere fact that some of them have continued in existence even in the face of tremendous yearly losses shows their own confidence in the future of this country; we have confidence in the reorganizing ability of our industrial enterprises to cope with ever-changing economic conditions; further, although our confidence wavers a bit here, we believe that what we have learned in this depression will serve to prevent, partially at least, another such occurrence although, economists tell us, depressions must be expected in the working of the existing economic cycle; and finally, we have confidence in our own ability to see this thing through and to enjoy the better days, which we are confident, will return again.

What is the best way to bring about a universal return of confidence? Our statement at the beginning of the above paragraph regarding the balancing of the budget probably is of particular significance inasmuch as a nationally balanced budget would do more than any other one thing to lead to complete restoration of confidence, and it is our expectation that we will see this come to pass.

According to Henry H. Heimann, executive manager of the National Association of Credit Men, budget balancing is the main road that leads to the restoration of confidence, to the checking of hoarding and to the release of buying power. Restoration of confidence would eventually lead to the culmination of the latter two objectives. It is lack of confidence that leads to hoarding and a tightening of buying power. He goes on to say:

"If this government does live within its income, confidence will increase not only in governmental but in other obligations. Government bonds, owing to the plethora of available liquid capital idle in banks, will immediately command an enviable investment attractiveness. Banks as well as private investors will rush to buy. Premiums will be paid and interest rates will be lowered on all governmental obligations.

"Even government bonds will be in such strong demand that the banks will soon find the interest return so low as to cause them to seek other investments. They will then turn to high grade industrial and utility bonds or bonds of states or political subdivisions thereof, particularly those states that have patterned their fiscal program in the wake of leadership which would be furnished by the national government. But these securities would be in such demand that it would soon become a seller's market with a drop in interest return that would cause the investor class to begin analyzing what might be called second grade or semi-speculative bonds of industries, utilities and carriers.

"All of these funds would swell the stream of credit for industry and commerce—confidence would once again return and banks would next venture into personal and industrial loans and business would no longer be restricted by lack of credit facilities. This series of events would so restore confidence that the pent-up demand, held back during three years by a wall of fear, would once again be released and a great advance toward prosperity under way. . . . .

"All history marks just one way to emerge from financial difficulties—and that is to live within your income. There is no magic in the restoration of prosperity. Let's stop deluding ourselves that the extraordinary agencies can be expected to do more than cushion the blow. We got into this situation by spending more than we had through the creation of counterfeit credit. It's time we lived within our budget and restored confidence, the cornerstone of sound credit."

Let us restore universal confidence by first balancing the budget.

Textile Foundation News

Cloth Mildew

Cloth mildew has a remarkable chameleon-like ability to assume a range of colorful hues, but its potential beauty fails to ameliorate its undesirable reputation with the textile industry, states Stuart W. Cramer, director of the Textile Foundation. Damage from or the cost of removing mildew probably involves the annual expenditure of millions of dollars in the United States alone. Fabrics in awnings, tents and tarpaulins, because of their exposure to dampness are especially subject to mildew which is sometimes termed "dry rot."

Exposure to varying intensity of light or heat and variable substances used in processing textiles may cause mildew to acquire quite different hues, but the ultimate ruinous effect is essentially the same. Owing to the costliness of textile mildew, considerable research, particularly in England, has been directed toward its elimination. Now a concerted attempt at mildew eradication is being supported by the Textile Foundation, according to Mr. Cramer.

The present research has both the prevention and treatment of mildew as its objectives, states Bernard S. Gould, a Boston man and Textile Foundation Research Fellow, who is working on the problem at the University of London, under the direction of Prof. Rainstrick, one of the leading English bio-chemists and bacteriologists.

"Textile mildew," Mr. Gould explained, "is an observable growth of microscopic plants similar to those found on over-ripe fruit, old tobacco and countless other articles. One angle of our problem is to develop, if possible, suitable antiseptics for prevening mildew by their incorporation into textile manufacturing processes. Previous efforts to that end have met with varied success.

"There is also the problem of dealing with the mildew once it has occurred, for often the damage is of so mild a nature that the fabric can be saved. Obviously it would be futile to attempt any work without a basic knowledge as to the fundamental chemical nature of the mold and its products, especially the colored substances or pigments.

"In order to properly eliminate mildew discoloration a thorough knowledge of mildew reactions and properties is necessary. It would be useless to try to eliminate a yellow color by the use of alkali if that particular pigment were to turn violet under an alkaline stimulus. It would be equally as futile to try to wash out a water-insoluble pigment. The isolation and analysis of the pure pigments is absolutely essential.

"There is the possibility that our research may have an incidental value to the dye chemist. The formulae for such beautiful hues as are produced naturally by micro-organisms may, quite likely, be of benefit to the dye industry. Invariably micro-organisms synthesize the only unknown of a series of compounds and often the most interesting one of all. They seem to be able to twist the molecules as man is unable to do. Although molds would be a very uneconomical source of pigment for large scale work a study of these might lead to a later synthesis from natural products."

Cheney Appointed Director

Frank Dexter Cheney of New York City, whose appointment as a director of the Textile Foundation to fill the unexpired term of Henry B. Thompson resigned, was recently announced, comes to the Board well fitted for his new responsibilties.

Since graduating from Yale in 1900, Mr. Cheney has been connected with the silk firm of Cheney Brothers in South Manchester, Connecticut, and New York City. He has been manager of their dyeing, printing and finishing works in Connecticut, and since 1919 has been general sales manager of the Cheney organization. During these years he has given special attention to various phases of scientific and economic research involved in production and merchandising problems.

In addition to his more intimate business connections, Mr. Cheney has devoted much time to public service. During the war he was a member of the Connecticut State Council of Defense, and also served as a member of the Dye Advisory Committee of the War Trade Board. He is a Trustee of Deerfield Academy at Deerfield, Massachusetts, and of Hotchkiss School, at Lakeville, Connecticut.

Laboratory List

The Textile Foundation in an effort to make an up-to-date directory of commercial textile testing laboratories, has addressed questionnaires to all available laboratories, using the various directories now published. The foundation requests any laboratory equipped to do textile testing on a pay basis, that has not received a questionnaire, to make application for one.

The Colorist and Co-operation

(Continued from page 174)

In some plants lack of knowledge of true costs is a weakness. It is not necessary to expand on the dangerous phase of this. The colorist's knowledge of his own costs and of other processes helps the company by giving him an incentive to change color shop methods to lower the costs of other processes in the plant. This may be applied to the possibility of shorter ageing, better color value, simpler aftertreatments and savings in the finishing department. As, for example, the selection of proper thickeners to allow the use of less softening material to produce soft finishes. At times the savings per yard may appear negligible but if you can save 1/10 cent per yard on a weekly production of half a million yards, you are saving $500 a week or $26,000 per year.

Now, a word about the technical men representing color manufacturers. These men are designed to be particularly of service to the colorist. Even if they have not been engaged in actual work in a print works, your help will permit them to become acquainted with commercial practice in the United States. There is sometimes hesitancy about allowing these technical men to enter your plant, but I have found that you can rely absolutely on their discretion. Their knowledge already acquired on the subject you discuss can to a large extent relieve your own color shop and laboratory of unnecessary work. In cases where they have had extensive experience in general print works problems I think you will find they are willing and glad to help on questions widely different from problems which they are demonstrating.

The Selling End

Having been a print works manager I can feel some sympathy with the selling end of your plants. It is very easy to claim that the salesmen should obtain better prices for their goods but, under the present conditions, it seems almost impossible to do so. The situation as it exists is very unsatisfactory in that there have been several attempts to arouse cooperation among various factories producing prints, but complete co-operation has never been obtained, perhaps due in part to fear of government interference, and those companies which find that they are able to cut prices below the market seem to set the standard for the rest of the industry. Theoretically this should be an incentive to get one's costs down to those which will compete with other units. At times local conditions in an organization make this impossible. It is very interesting—if not amusing—to listen in on meetings involving plant executives and the selling end and hear the two factions pass the buck to each other. The salesmen claim that they cannot get better prices, so the only salvation is to lower plant costs. The operating men come back with the argument that costs are as low as can be made and that the selling prices should be raised to a point where at least costs can be covered. At the end of the meeting those present have got exactly nowhere although I believe that the contending sides are in sympathy with each other.

In such a buyers' market as this there may be a tendency to give the customer only his money's worth as far as quality is concerned, but we must always consider the danger of the ultimate consumer deciding that prints are not satisfactory as a whole and that it is to his advantage to shift to plain shades or ginghams for at least a season. This leaves the print works in a worse condition than ever. Moreover, in late years, buyers have been so accustomed to goods of guaranteed fastness that they will take every opportunity to return goods as not meeting guarantees.

Daily Troubles

The uncertainty of the present day is perhaps due as largely as anything else to the fact that the owner or manager is at the mercy of unscrupulous customers who claim that they can get goods cheaper than quoted by changing to some other plants. It is impossible to confirm such a statement immediately at the time when a quotation must be made. It is often stated, and there may be some truth in it, that there are a great many more printing machines than are necessary to supply the demand, yet at times practically all the plants are busy day and night. It is natural for a company receiving a large amount of orders requiring immediate delivery to run the machines at top speed in order not to lose the business to someone else; thus, instead of creating a scarcity of goods with a consequent possibility of raising prices, the demand at the low prices is easily filled and so the printers are no better off than ever and the goods are practically given away. Of course, this is another argument for keeping down costs to meet the selling prices if possible and, where it is not possible to break even on staple lines, the only possibility is to produce novel or unusual effects so that higher charges may be made for the goods—all of this requiring even greater industry and ingenuity on the part of the individual colorist.

I am mentioning all this to emphasize the need of co-operation between the salesmen of your goods and yourselves. The effect of such co-operation may have a lasting effect in educating the salesmen to the natural limits

of printing, and we hope that any ideas gained by them may persist during the better times to come.

Indigosols

I have spoken earlier of the necessity for instituting new developments for the purpose of saving money for a concern. This naturally brings me to a few words with reference to one of the most important recent developments in dyestuffs. That in which I am naturally most interested is the subject of Indigosols. A great many of you are thoroughly familiar with these colors since they are being used in large quantities. The use of these colors affords an example of cost cutting without sacrificing quality, the amount of money saved by many plants using these dyestuffs being very considerable, amounting in some cases to 30 to 50 per cent of the color cost. Some plants have been rather backward about taking up their use but they will consider it seriously if they keep in mind the fact that very large yardages are being printed with Indigosols and giving perfect satisfaction.

For the sake of some of you who are not particularly well acquainted with the colors, I will take a few minutes in closing in describing them.

The methods of application are very simple and effective and produce in a great many cases results superior to the ordinary vat colors. Any characteristic difficulties are slight and do not present obstacles which need worry any able color shop man.

As received in the color shop Indigosols are sulphuric acid esters of leuco or reduced vat colors. After they have been printed and developed they have reverted back to the exact form of ordinary vats so that there need be no doubts as to their fastness to any influence which the corresponding vat colors will stand. In plain English we might call them "water-soluble vat colors."

In most cases they are dry powders which are completely dissolved in such solvents as Urea and Cellosolve. The most essential requirement in the color shop is that complete solution be assured. As a rule all that is left is to thicken the color with the addition of neutral chromate of soda.

One Advantage

An outstanding advantage of Indigosols, at least from the standpoint of low cost of printed shades, is their adaptability to mixing with Pharmol Blue or Yellow or any of the Rapidogens or Rapid Fast Colors. Thus a range of shades strictly comparable with those produced by ordinary vat colors may be obtained. The Rapidogens, of course, are stable mixtures of the Fast Color salts and naphthol bases.

After printing, if the Indigosols are mixed with Rapidogens, the goods are aged at about 210 deg. F. or over in the presence of steam and acetic acid fumes. In the ageing an outstanding advantage of these colors is the fact that no care is required to keep the box free from air; it is simply necessary to prevent the decomposition of the Rapidogens by being sure that the colors entering the ager immediately are exposed to acetic acid fumes and not too high temperatures lacking in acid. A number of simple methods for putting the acid into the box are used. For instance, running it in through a pipe onto a hot plate in a regular hydrosulphite ager; blowing it in with the steam supply; or providing the box with a small tank of acetic acid in which some steam coils are placed. Several plants are installing special agers in the form of a wooden box which is durable and cheap.

After ageing—or even before—the goods can be allowed to lie indefinitely before development provided they are protected from the action of light. After ageing, the goods are developed in the open with an acid oxidizing material, the best average results having been obtained by the use of copperas ferric nitrate and sulphuric acid at a temperature of 170-180 deg. F. This is a corrosive liquid and, at the high temperature used, we have found it greatly to the advantage of a plant to install a completely rubber-lined box so that all iron work is well protected. Bearings should be rubber and gudgeons Allegheny metal, or the gudgeons may be completely covered with rubber. A standard box of this type is now available at a moderate cost. Lead-lined tanks, while satisfactory for a short time, show a tendency to warp and buckle and finally to break away at the corners. The goods, having been passed through the oxidizing solution and skied for 10 to 15 seconds, are rinsed, passed through oxalic acid to clear the whites, rinsed and soaped. They are then ready for finishing.

As far as the fastness of these colors is concerned, it is only necessary to make the proper selection as you would with ordinary vat colors, the Indigosols being exactly as fast as the corresponding vat. Some of them are derived from the Indigoid series and some from the Indanthrenes.

Fast Browns

Particular success, as far as cost is concerned, has been met with in the production of fast browns which we all know to be expensive when printed with vat colors of the required fastness. This brown is made with Rapid Fast Orange and an Indigosol Blue, usually Indigosol AZG. We have prints produced practically which show very great savings. Other shades in medium and light strengths are being turned out with comparable savings.

If there are any of you who are not acquainted with this series of colors, I think it will be well worth your while to look into them—not because I am identified with a company which is selling them, but because many plants have found their use of great advantage, particularly from the standpoint of the saving of money; and you can be assured that the Carbic Color and Chemical Company, Inc., will welcome the opportunity to help out in any way and will try to give an example of the co-operation which I have been talking about.

BOOK REVIEWS

Colloid Chemistry, Theoretical and Applied. *Volume IV. By selected International Contributors. Collected and edited by Jerome Alexander. p. 734. The Chemical Catalog Co.* $11.50.

This book concludes the series of four volumes originally planned. Vol. I was devoted to Theory and Methods; Vol. II to Biology and Medicine, and Vols. III and IV to Technological Applications. This particular volume should prove of interest to textile chemists and colorists, because it carries sections in regard to the Carbohydrates including Cellulose, Starch Products, Sizing, Dyeing, Color Lakes, Laundry and Dry Cleaning, Water Supply and Sewage Disposal. The extensive bibliographies which accompany many of the sections should prove of value to users of the book. The whole series of four volumes will make a valuable addition to any chemist's library, not alone as a work of reference, but to furnish interesting reading and to broaden the scope of his general knowledge of the wide range of subjects which may be said to involve colloidal chemical principles.

Handbook of Chemistry and Physics. *Seventeenth Edition. Chemical Rubber Co., Cleveland, Ohio. p. 1722.*

In the preparation of the seventeenth edition of this excellent Handbook of Chemistry and Physics, an unusually extensive revision has been made. Many of the tables have been revised and enlarged, two hundred fifty pages have been extensively changed, and, including revisions and entirely new material, approximately one hundred and fifty pages have been added. The table of Physical Constants of Organic Compounds has been completely recompiled and presented in a much improved form.

The general features and scheme of arrangement which have received extensive endorsement in former editions have been retained. An endeavor has been made to incorporate into this volume all general data that will be of value to the chemist and physicist. The editor and the publisher are to be commended for making available such a useful and complete reference manual. It should find a place in every chemist's reference library.

Dye Import Tariff in Japan

According to the *Journal of the Japanese Textile Association* there seems to be considerable discussion in Japan regarding tariffs on dyes imported in Japan. At a recent meeting in Osaka it was decided to petition the Minister of Finance to reduce the import duty. The petition set forth the following facts as a basis for the requested reduction.

1. Fifty-six per cent of the cotton goods exported from Japan are piece-dyed.

2. These piece goods should be made of a higher quality by using faster dyes.

3. Faster dyes must be cheaply supplied.

4. Total imports of dyes during the first nine months of 1932 amounted to 2,837,000 kin, while during the twelve months of 1931 they amounted to only 2,700,000 kin.

5. Japanese dye manufacturers have had extraordinary protection from the government since the beginning of the World War, but as yet they have not been able to supply dyes of higher quality such as vat dyes.

6. If the market prices of dyes are to continue at their present high levels the fastness of dyed goods will necessarily decrease.

7. Those dyes not manufactured in Japan should be imported free of duty.

The domestic dye manufacturers, of course, express different opinions and there seems to be an indication of considerable discussion concerning the dye import tariff.

New General Dyestuff Circulars

The General Dyestuff Corporation has recently issued circulars pertaining to the following products:

Laventine HW—a grease solvent for use in the dyebath, laundry and in scouring.

Indanthrene Golden Orange 3GA Paste—similar in fastness properties to Indanthrene Orange 3G Paste but dyes slightly yellower and brighter.

Emulphor O—a new type of emulsifier for Olein.

Indanthrene Printing Brown 5R Suprafix — a new homogeneous vat dye, said to yield clear copper brown shades of excellent fastness to light, washing and chlorine.

Fast Sulphon Black NB—a new acid black, recommended by the manufacturer especially for the knitting trade as it is said to have very good fastness to perspiration.

Wool Fast Blue FFG—recommended by the manufacturer for dyeing and colored discharge work on silk.

Igepon A—circular discusses use in the preparation of worsted and woolen fabrics.

Rapidogen Dyestuffs—circular illustrates use of colored resists with Rapidogen dyestuffs under aniline black.

Acetate Silk Dyes—circular illustrates Celliton, Celliton Fast, Cellit, Cellit Fast Dyestuffs and Cellitazols on Acetate Silk.

Leophen M—an auxiliary for mercerizing liquors.

Naphthol AS-ITR—a new naphtol of the "AS" series, said to be of particular interest for the production of fast to light pinks.

Copies of any or all of the above circulars may be obtainable upon request.

Chemical Resistance of Rubber

Reprints of a paper on "The Chemical Resistance of Rubber as an Engineering Material," delivered before the American Society for Testing Materials are available upon request to the B. F. Goodrich Rubber Company, Akron, Ohio. Dr. Howard E. Fritz and J. R. Hoover of the chemical sales division of the company are the authors.

This paper is a summary of data pertinent to the industrial applications of rubber in resisting corrosion or avoiding contamination. Vulcanized rubber can be compounded to resist actual immersion for long periods in any of the inorganic acids except those of strong oxidizing character and can likewise be made inert to most inorganic salts and to many commercial organic materials.

Tables showing some of the industrial chemicals which are successfully handled in rubber-lined process equipment are included. Limiting factors are discussed, most important among which are temperature, vigorous ozidizing agents and certain classes of organic materials.

An outline of the major fields of application for rubber in various types of service is presented. Emphasis is laid on the necessity for accurate definition of service conditions and requirements by engineers who plan to use rubber.

Amapro Union Colors

The American Aniline Products, Inc., has recently issued a color card displaying "Amapro Union Colors on Garnetted Stock."

The card displays eighteen shades which includes the entire range of style shades. The formula used and the composition of the stock is given, and it is worth noting that the dyes appear to have colored the mixed stock uniformly.

NEW PATENTS

(*Abstracted by Synthetic Organic Chemical Mfrs. Assn.*)

Process for Manufacturing Azodyestuffs. (Yield a wide range of blue dyeings distinguished by an excellent discharging ability.) Leopold Laska, Arthur Zitscher, Wilhelm Christ, and Adolf Petzold, of Offenbach-on-the-Main, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,878,243, Sept. 20, 1932.

(*New*) *Azo Dyestuff.* (Yielding on cotton clear yellow to brown dyeings.) Karl Dobmaier, of Wiesdorf, Ger., assignor to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,878,471, Sept. 20, 1932.

Stilbene Dye and Process of Producing the Same. (Relates particularly to improvements in the manufacture of stilbene azo dyestuffs by the reduction of 4.4'-dinitrostilbene-2.2'-disulfonic acid in an alkaline medium, by emplying an aldehyde as reducing agent.) Chauncey Allan Lyford, of East Aurora, N. Y., assignor to National Aniline & Chemical Co., Inc., of N. Y., N. Y., No. 1,878,501, Sept. 20, 1932.

Production of Malachite Green. (A new method of producing the color base of malachite green whereby the troublesome and expensive methods of purification heretofore practiced are eliminated.) Lucas P. Kyrides, of Buffalo, N. Y., assignor to National Aniline & Chemical Co., Inc., of N. Y., N. Y., No. 1, 878,530, Sept. 20, 1932.

Dyestuffs of the Safranine Series and the Process of Making Them. (Dye wool from an acid bath intense reddish violet to greenish blue shades.) Wilhelm Neelmeier and Theodor Nocken, of Leverkusen-on-the-Rhine, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,878,531, Sept. 20, 1932.

Monoaroyldiamines of the Benzene Series. (More specifically, monoaroylphenylenediamines, being intermediate products for azo dyestuffs.) Eugen Rimele, Eugen Glietenberg, and Wilhelm Neelmeier, of Leverkusen-on-the-Rhine, Ger., assignors to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,878,543, Sept. 20, 1932.

Asymmetric Polymethine Dyestuffs. (Difficultly soluble in cold water, dyeing blue to green shades.) Ottmar Wahl, of Leverkusen-on-the-Rhine, Ger., assignor to General Aniline Wks., Inc., of N. Y., N. Y., No. 1,878,557, Sept. 20, 1932.

CLASSIFIED

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

COLOR CHEMIST. Graduate Chemist with five years' experience in large Eastern Print and Finishing Plant. Formerly in charge of laboratory and plant research. Excellent references. Address Box No. 769, American Dyestuff Reporter, 440 Fourth Avenue, New York.

POSITION WANTED—Position as foreman of folding, packing, and shipping department. Thoroughly experienced in cotton, cotton and rayon, celanese, acetate and all artificial silks and their put-ups. Also a wide experience on prints. Best of references. Will go anywhere. Address Box No. 770, American Dyestuff Reporter, 440 Fourth Avenue, New York.

WANTED—Ribbon Dyer and Finisher to take charge of small department in a Canadian plant. Must be familiar with silk, cotton and rayon mixtures, as well as yarn dyeing. Write full details of age, experience, salary expected, etc., to Box No. 771, American Dyestuff Reporter, 440 Fourth Avenue, New York, N. Y.

GRADUATE: Textile Student, age 24; three years large finishing plant, color shop experience. Experienced with fast colors on cotton and rayon; also with silk colors. References. Address Box No. 772, American Dyestuff Reporter, 440 Fourth Avenue, New York.